

## RESEARCH ARTICLE

# The bat fauna (Mammalia: Chiroptera) of Carlos Botelho State Park, Atlantic Forest of Southeastern Brazil, including new distribution records for the state of São Paulo

Vinícius C. Cláudio<sup>1,2,3</sup>, Gedimar P. Barbosa<sup>1,2</sup>, Vlamir J. Rocha<sup>4</sup>,  
Ricardo Moratelli<sup>5</sup>, Fabrício B. Rassy<sup>1,2</sup>

<sup>1</sup>Centro de Ciências Biológicas e da Saúde, Universidade Federal de São Carlos. 13565-905 São Carlos, SP, Brazil.

<sup>2</sup>Fundação Parque Zoológico de São Paulo. 04301-905 São Paulo, SP, Brazil.

<sup>3</sup>Instituto de Biologia, Programa de Pós-Graduação em Biodiversidade e Biologia Evolutiva, Universidade Federal do Rio de Janeiro. 21941-902 Rio de Janeiro, RJ, Brazil.

<sup>4</sup>Centro de Ciências Agrárias, Universidade Federal de São Carlos. 13600-970 Araras, SP, Brazil.

<sup>5</sup>Fiocruz Mata Atlântica, Fundação Oswaldo Cruz. 22713-560 Rio de Janeiro, RJ, Brazil.

Corresponding author: Vinícius Cardoso Cláudio ([vcclaud@gmail.com](mailto:vcclaud@gmail.com))

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**ABSTRACT.** Carlos Botelho State Park (PECB) is a large remnant of Atlantic Forest in Southeastern Brazil, with more than 37,000 ha. As its bat fauna is still unknown, we performed the first bat survey on PECB, to provide data on the distribution, natural history and taxonomy of the species. Fieldwork was conducted monthly, from October 2016 to September 2017. Captures were made using ground-level mist-nets (39600 m<sup>2</sup>.h), canopy mist-nets (2017.5 m<sup>2</sup>.h) and searches for roosts (42 hours). We captured 412 bats from 34 species of Phyllostomidae, Molossidae and Vespertilionidae. A total of 11 species were captured only in ground-level mist-nets, five in canopy mist-nets, and seven in roosts. *Dermanura cinerea* Gervais, 1856, *Eptesicus taddeii* Miranda, Bernardi & Passos, 2006, *Glyphonhycteris sylvestris* Thomas, 1896 and *Lampronhycteris brachyotis* (Dobson, 1879) are rare on surveys conducted in the Atlantic Forest of São Paulo and were captured in canopy mist-nets. *Micronhycteris schmidtorum* Sanborn, 1935 and *Molossus currentium* Thomas, 1901 constitute the first record for the state of São Paulo, and were captured in canopy mist-nets and roosts, respectively. The species richness registered for PECB surpasses other surveys conducted in Atlantic Forest localities that use only ground-level mist-nets. Our results reinforce the importance of employing mixed capture methods, such as elevated mist-nets and searches for roosts.

**KEY WORDS.** Capture methods; morphology; survey; taxonomy.

## INTRODUCTION

The Atlantic Forest includes a large variety of phytophys-  
iognomies, leading to an expressive environmental diversity,  
which has provided conditions for the occurrence of numerous  
species, resulting in the establishment of an extremely rich biotic  
complex (Campanili and Schaffer 2010). Due to its large biolog-  
ical diversity, the biome has been recognized as one of the 25  
biodiversity hot spots, and one of the richest ecological regions  
in the world (Myers et al. 2000, Campanili and Schaffer 2010).

Currently, Atlantic Forest remnants comprise 28% of  
their original area, considering all the successional stages and  
phytophysognomies: forests, natural grasslands, restingas and  
mangroves (MMA 2006, Rezende et al. 2018). However, forest

remnants larger than 100 ha correspond to about 8% of the orig-  
inal biome's size, and the combined area of the 232,939 native  
forest fragments, larger than 3 ha, total 11.4% of the original area;  
additionally, only 30% of the total remnants are located inside  
protected areas (147,018 km<sup>2</sup> – Fundação SOS Mata Atlântica  
2012, Rezende et al. 2018). This is the consequence of a history of  
exploitation of the biome and represents a threat to the Atlantic  
Forest biodiversity. These threats include the anthropic influence  
on the environment integrity, deforestation and loss of habitat;  
illegal activities and overexploitation of species for human use;  
and introduction of exotic species; and other disturbances (Pinto  
and Brito 2005, Tabarelli et al. 2005, Brito 2006). These factors  
continue to push many species to the threshold of extinction  
(Pinto and Brito 2005, Tabarelli et al. 2005, Brito 2006).



The larger remnants and endemism areas of the biome are located on Southeast and South regions, key regions to conservation strategies (Costa et al. 2000). A total of 321 mammal species are registered for the Atlantic Forest, from which 120 species are bats, 89 species are considered endemic to the biome and 38 species are threatened (Campanili and Schaffer 2010, Paglia et al. 2012, Graipel et al. 2017). Within these bat species, four are currently classified as “Vulnerable” in the last Brazilian list of threatened species: *Furipterus horrens* (Cuvier, 1828), *Natalus macrourus* (Gervais, 1856), *Lonchorhina aurita* Tomes, 1863 and *Eptesicus taddeii* Miranda, Bernardi & Passos, 2006 (ICMBio 2018). Additionally, Garbino (2016) listed 79 bat species for the state of São Paulo.

Due to their large niche breadth, bats play indispensable ecological roles in tropical forests (Kalko 1998). They have a great importance on ecosystems maintenance, acting on plant pollination and seed dispersal, and control of insect population, including agriculture plagues (Goodwin and Greenhal 1961, Vogel 1969, Pijl 1975, Peracchi et al. 2006, Cleveland et al. 2006). Therefore, bats are considered indicators of functional integrity of communities (Medellín et al. 2000). Despite their ecological roles and the major threats to their conservation, the basic scientific knowledge on these mammals is scarce. Several species lack information on biology, taxonomy, systematics, distribution and natural history, and are listed as Data Deficient on lists of threatened species. Additionally, these lists also include recently described or locally rare species, although widely distributed, since the number of bat inventories in Brazil is still insufficient and there are many data-poor areas (Costa et al. 2005, Reis et al. 2007, Bernard et al. 2011).

Species identifications can be major impediment to interpreting inventory results (Simmons and Voss 1998, Costa et al. 2005, Gregorin et al. 2011b). Field identification of bats may bring some difficulties, since species-level identification of many genera includes skull and teeth characters, which may be visible only in laboratory (Dias and Peracchi 2008). Additionally, more detailed identification keys are based on those characters and do not include diagnostic features of external morphology, making fieldwork harder, especially for non-taxonomists, and generating a high number of erroneous species identifications on lists and inventories. The collection of voucher specimens to afford studies of external morphology, the development of museum studies and revisions, and the intensification of fieldwork and inventories, are important to improve the knowledge on bats (Bergallo et al. 2000, Patterson 2001, 2002, Bernard et al. 2011). In this way, we provide the first list of bats for the Carlos Botelho State Park, a large remnant of Atlantic Forest in southeastern Brazil, employing distinct and complementary methodologies of capture. In addition, we provide taxonomic data for all the species captured, focusing on external morphology and diagnostic characters in order to support future studies.

## MATERIAL AND METHODS

The Carlos Botelho State Park (Parque Estadual Carlos Botelho – PECB) is a protected area created in 1982 (24°06′55″–24°14′41″S; 47°47′18″–48°07′17″W; Fig. 1 [São Paulo 2008]). It comprises 37,644 ha of Atlantic Forest, with ca. 62% of the total area composed by pristine forests, presenting high biodiversity and unique, rare or fragile phytophysognomies. The ombrophilous forest is the most representative major phytophysognomy, covering almost the entire area, whereas shrub grasslands are restricted to a small area. Climate in the region is classified as Cfb (Kottek et al. 2006), with medium temperatures ranging from 17 to 22 °C (São Paulo 2008). December, January and February are the hottest months, with average temperature of 25 °C; and June, July and August are the coldest months, with average temperature of 18 °C. Pluviosity ranges from 1700 to 2400 mm, without dry months throughout the year. Elevation ranges from 20 to 940 m (Ponçano et al. 1981, São Paulo 2008).

From October 2016 to September 2017, we conducted 48 nights of sampling at PECB in localities ranging from 80 to 850 m of elevation. On each night 10 ground-level mist-nets (0.5–3 m height) and one canopy mist-net (~ 8–10.5 m) were used. Nets remained opened from dusk to 4 hours after sunset, and samplings were conducted during the new moon (Esbérard 2007). Sampling effort was calculated according to Straube and Bianconi (2002). Sampling sites (Fig. 1) included natural openings, streams and rivers, potential roosts, fructifying and flowering plants (Marinho-Filho 1991). Additionally, we conducted active searches for roosts, guided by interviews with the local staff and looking for sites that could roost bats, such as hollow trees, fallen trees, rocks, foliage and human buildings (Simmons and Voss 1998).

Field identifications were based on keys provided by Gardner (2008a), Díaz et al. (2016), López-Baucells et al. (2016) and Reis et al. (2017). The following external measurements and the weight (W) were taken using a digital caliper (0.01 mm accuracy) for all adults captured: body length (BL), forearm length (FA), tibia length (TL), ear length (EL), and tragus length (TRL). Qualitative diagnostic characters were also analyzed according to Dias and Peracchi (2008), such as: pelage color, pelage texture, teeth morphology, and uropatagium, ears and tragus shape. Most individuals were marked and released in the field, but one adult male and one adult female of each species were collected as vouchers – except for species with only one capture. A total of 60 specimens were collected under the permits SISBIO/ICMBIO 54.381-1/2016 and COTEC/SMA-IF 260108-006.479/2016. They were euthanized using the inhalational anesthetic Halothane, and fixed with 10% of buffered formalin and preserved in 70° GL alcohol, with skull removed. Vouchers are deposited in the collections of the Universidade Federal de São Carlos, Campus Sorocaba (ZSP; Sorocaba, Brazil), and the Museu Nacional, Universidade Federal do Rio de Janeiro (MN; Rio de Janeiro, Brazil [see Table 1]).



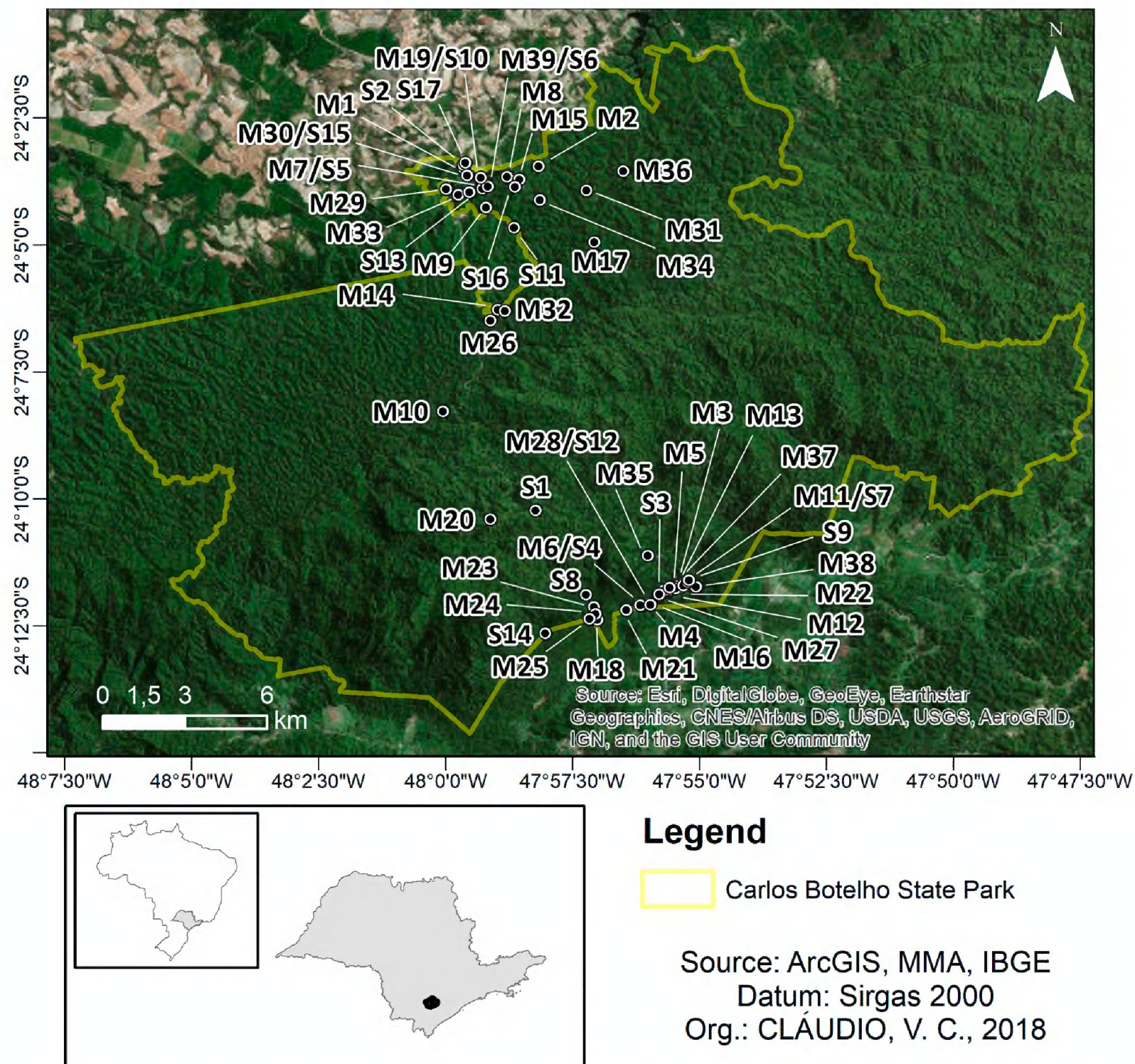


Figure 1. Sampling sites and location of the Carlos Botelho State Park in the São Paulo state, southeastern Brazil. Code numbers correspond to sampling sites indicated in the Appendix 1. M: mist-net sites; S: search for roosts sites.

Thirteen skull measurements based on Velazco et al. (2010) were taken from voucher specimens using a digital caliper (0.01 mm accuracy): greatest length of skull, including internal incisors (GLS); condyloincisive length (CI); braincase breadth (BB); zygomatic breadth (ZB); postorbital breadth (PB); palatal width at canines (CC); mastoid breadth (MB); palatal length (PL); maxillary tooththrow length (MXTL); molariform tooththrow length (MLTL); dentary length (DL); mandibular tooththrow length (MNTL) and coronoid height (CH). Additional external and skull measurements were taken when necessary, and are commented in the text along the analyzed species.

Randomized accumulation curves were constructed to assess the completeness of sampling effort and compare different survey techniques, according to Cowell et al. (2012), using the software R (R Core Team 2019).

## RESULTS AND DISCUSSION

### Analysis of the sampling

We captured 412 bats, distributed into three families and 34 species (Table 1). Among them, we recorded 22 species on 39,600 m<sup>2</sup>.h of ground-level mist-nets (304 captures; Fig. 2), 14 species on 2,018 m<sup>2</sup>.h of canopy mist-nets (41 captures; Fig. 2), and 11 species on 42 hours of search for roosts (67 captures; Fig. 3). The number of species recorded for the PECB is higher than that obtained for most localities in the Atlantic Forest of Southeastern Brazil (Table 2). The comparison of our results with the results obtained in other surveys ratify the importance of multiple methods for a more comprehensive sampling of the bat diversity.

The randomized accumulation curve of ground-level mist-nets captures showed a slight tendency to level off, however,



Table 1. Bat species from Carlos Botelho State Park, São Paulo, Brazil, captures divided by sampling method and voucher specimens in the collections of Universidade Federal de São Carlos – campus Sorocaba (ZSP) and the Museu Nacional, Universidade Federal do Rio de Janeiro (MN).

Species	Method			Total	Voucher material
	Ground	Canopy	Roost		
Phyllostomidae					
Micronycterinae					
<i>Lamproncyteris brachyotis</i> (Dobson, 1879)	–	1	–	1	ZSP 040
<i>Micronycteris microtis</i> Miller, 1898	2	–	–	2	ZSP 011, ZSP 028
<i>Micronycteris schimdtorum</i> Sanborn, 1935	–	1	–	1	ZSP 013
Desmodontinae					
<i>Desmodus rotundus</i> (É. Geoffroy, 1810)	16	2	–	18	ZSP 006, ZSP 031
<i>Diphylla ecaudata</i> (Jentink, 1893)	4	–	–	4	ZSP 039, ZSP 049
Phyllostominae					
<i>Mimon bennettii</i> (Gray, 1838)	1	–	–	1	ZSP 041
<i>Trachops cirrhosus</i> (Spix, 1823)	3	–	–	3	ZSP 024
Glossophaginae					
<i>Anoura caudifer</i> (É. Geoffroy, 1818)	20	6	15	41	ZSP 001, ZSP 012
<i>Anoura geoffroyi</i> Gray, 1838	22	6	–	28	ZSP 014, ZSP 057
<i>Glossophaga soricina</i> (Pallas, 1766)	–	–	1	1	ZSP 060
Carollinae					
<i>Carollia perspicillata</i> (Linnaeus, 1758)	95	–	–	95	ZSP 008, ZSP 022, ZSP 023, ZSP 045
Glyphonycterinae					
<i>Glyphonycteris sylvestris</i> Thomas, 1896	–	2	–	2	ZSP 033, ZSP 042
Stenodermatinae					
<i>Artibeus fimbriatus</i> Gray, 1838	37	8	1	46	ZSP 027, ZSP 037
<i>Artibeus lituratus</i> (Olfers, 1818)	7	3	–	10	ZSP 015, ZSP 056
<i>Artibeus obscurus</i> (Schinz, 1821)	27	4	–	31	ZSP 009, ZSP 025
<i>Dermanura cinerea</i> Gervais, 1856	7	1	–	8	ZSP 035, ZSP 036
<i>Platyrrhinus lineatus</i> (É. Geoffroy, 1810)	–	1	–	1	ZSP 032
<i>Platyrrhinus recifinus</i> (Thomas, 1901)	1	–	–	1	ZSP 055
<i>Pygoderma bilabiatum</i> (Wagner, 1843)	3	–	–	3	ZSP 043, ZSP 044
<i>Sturnira lilium</i> (É. Geoffroy, 1810)	27	4	–	31	ZSP 002
<i>Sturnira tildae</i> de la Torre, 1959	5	–	–	5	ZSP 029, ZSP 038
<i>Vampyressa pusilla</i> (Wagner, 1843)	1	–	–	1	ZSP 058
Molossidae					
Molossinae					
<i>Cynomops abrasus</i> (Temminck, 1826)	–	–	1	1	ZSP 021
<i>Molossops neglectus</i> Williams & Genoways, 1980	–	1	–	1	ZSP 016
<i>Molossus currentium</i> Thomas, 1901	–	–	1	1	ZSP 050
<i>Molossus molossus</i> (Pallas, 1766)	–	–	28	28	ZSP 003, ZSP 018, ZSP 020, ZSP 053
<i>Molossus rufus</i> É. Geoffroy, 1805	–	–	3	3	ZSP 019, ZSP 026, ZSP 059
Vespertilionidae					
Vespertilioninae					
<i>Eptesicus taddeii</i> Miranda, Bernardi & Passos, 2006	2	1	–	3	ZSP 017, ZSP 048
<i>Histiotus velatus</i> (L. Geoffroy, 1824)	–	–	13	13	ZSP 004, ZSP 046
<i>Lasiurus ebenus</i> Fazzolari-Corrêa, 1994	1	–	–	1	MN 83982
Myotinae					
<i>Myotis albescens</i> (É. Geoffroy, 1806)	–	–	2	2	ZSP 005
<i>Myotis nigricans</i> (Schinz, 1821)	20	–	1	21	ZSP 010, ZSP 051
<i>Myotis riparius</i> Handley, 1960	2	–	–	2	ZSP 007, ZSP 052
<i>Myotis ruber</i> (É. Geoffroy, 1806)	1	–	1	2	ZSP 047, ZSP 054
Total species	22	14	11	34	–
Total captures	304	41	67	412	–



Table 2. Comparison between the results of bat inventories conducted in the Atlantic Forest of Southeastern Brazil, including sampling efforts, number of captures and species, and sampling methods. \*Mist-nets installed inside roosting sites (caves).

Protected area, state	Sampling effort	Number of species	Number of captures	Sampling methods	References
Parque Estadual da Cantareira, São Paulo	136,080 m <sup>2</sup> .h	22	598	Ground-level mist-nets	Aires (2003)
Parque Estadual Intervales, São Paulo	-	24	371	Ground-level mist-nets	Passos et al. (2003)
Parque Estadual da Ilha do Cardoso, São Paulo	61,776 m <sup>2</sup> .h	27	393	Ground-level mist-nets	Fazzolari-Corrêa (1995)
Reserva Biológica do Tinguá, Rio de Janeiro	-	28	655	Ground-level mist-nets	Dias and Peracchi (2008)
Parque Estadual Carlos Botelho, São Paulo	41,618 m <sup>2</sup> .h, 42h of search for roosts	34	412	Ground-level mist-nets, elevated mist-nets, and search for roosts	This study
Parque Estadual Turístico do Alto Ribeira, São Paulo	25,320 m <sup>2</sup> .h	35	2002	Ground-level mist-nets, elevated mist-nets, and search for roosts*	Arnone (2008)

the curve is still in an accumulation stage (Fig. 2). Effectiveness of this sampling technique, however, is directly related to phyllostomid captures, with other families usually under-represented (Simmons and Voss 1998, Bergallo et al. 2003). Curves of canopy mist-net and roost captures, on the other hand, were clearly in an accumulation stage (Figs 2, 3), showing that more effort could lead to an increase in the species list presented here, mainly by the addition of rare species, as reported in other studies (see Voss and Emmons 1996, Simmons and Voss 1998, Feijó and Rocha 2017, Gregorin et al. 2017). Besides the accumulation curves, the number of captures should also be considered when analyzing the completeness of the sampling effort. According to Bergallo et al. (2003), at least 1000 captures are necessary to sample the majority of phyllostomid species in Atlantic Forest areas. Thus, despite presenting a high richness, a larger sampling period and additional captures could also increase the number of species registered in PECB. According to Arnone (2008), even though 2,002 captures and 35 species were registered in Parque Estadual Turístico do Alto Ribeira, São Paulo, a higher number of species possibly occur in the area.

Among the 34 species reported, 11 were obtained exclusively with ground-level mist nets, five exclusively with canopy mist-nets, and seven exclusively with the search for roosts. Additionally, the first occurrence records for *Micronycteris schmidtorum* Sanborn, 1935 and *Molossus currentium* Thomas, 1901 for the state of São Paulo, along with all other molossids captured, were made with canopy nets or search for roosts. Molossids are rarely captured in ground-level mist-nets due to its foraging habits (Kalko et al. 1996, Simmons and Voss 1998, Gregorin et al. 2017). Few species rarely registered in the state of São Paulo, such as *Dermanura cinerea* Gervais, 1856, *Eptesicus taddeii*, *Glyphonhycteris sylvestris* Thomas, 1896 and *Lampronhycteris brachyotis* (Dobson, 1879) (see Garbino 2016), were also captured with those complementary methods.

The employment of mixed methodologies for bat sampling also showed positive results in other studies and it has been encouraged by many authors (Simmons and Voss 1998, Feijó and Rocha 2017, Gregorin et al. 2017). Beyond the role in complementing the species list, the rate of bats captured in the canopy (one capture for each 49.2 m<sup>2</sup>.h) was higher than that in the ground-level nets (one capture for each 130.2 m<sup>2</sup>.h). The complementary methods used methodologies allowed to register

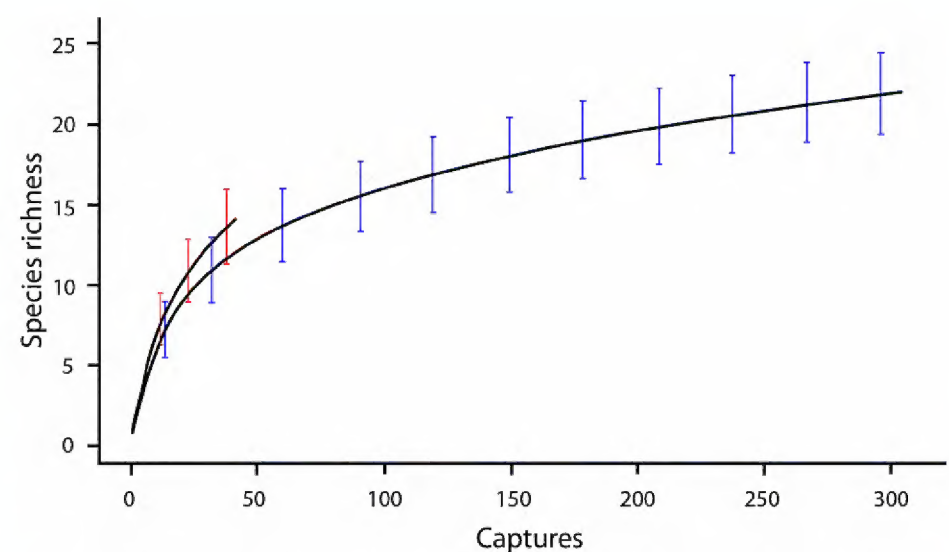


Figure 2. Individual-based species accumulation curve of bat species captured in Parque Estadual Carlos Botelho with 39,600 m<sup>2</sup>.h of ground-level mist-nets (Blue), and with 2017.5 m<sup>2</sup>.h of canopy mist-nets (Red); the analysis of the curve indicates that it is still in an accumulation stage. Error bars show confidence interval (95%).

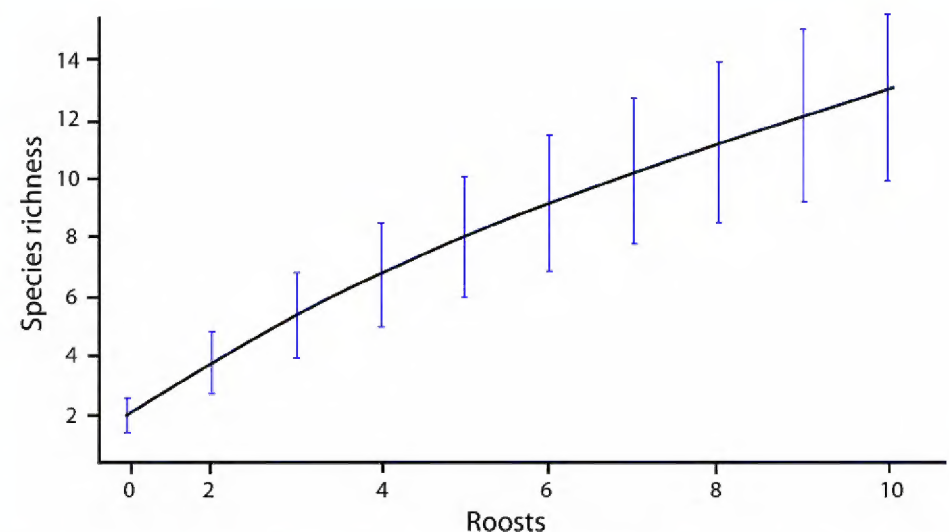


Figure 3. Sample-based species accumulation curve of bat species captured in Parque Estadual Carlos Botelho with 42 hours of search for roosts; the analysis of the curve indicates that it is still in an accumulation stage. Error bars show confidence interval (95%).

rarely captured species, and provided complementary and more robust information on their abundance. The selectivity of the ground-level mist-nets could lead to the misinterpretation of species abundance, once species rarely captured in ground-level mist-nets do not necessarily present low local abundances and could be more efficiently sampled with different methods (Feijó



and Rocha 2017). Therefore, we encourage the use of mixed methodologies and reinforce that continued survey on the Park could enlarge the species list and provide additional information on the local species.

#### Taxonomic accounts

Below we provide the list of species, identification, morphology description, distribution and natural history notes for all the species captured on PECB. The taxonomic arrangement and nomenclature follow Nogueira et al. (2014), with the updates made by Nogueira et al. (2018).

### Phyllostomidae Gray, 1825

#### Micronycterinae Baker, Hood & Honeycutt, 1989

##### *Lampronycteris brachyotis* (Dobson, 1879)

Fig. 4

**Taxonomy.** *Lampronycteris* Sanborn is a monotypic genus represented by *L. brachyotis* Dobson, 1879. It is morphologically similar to *Glyphonycteris* O. Thomas, 1896, *Micronycteris* Gray, 1866, *Neonycteris* Sanborn, 1949, and *Trinycteris* Sanborn, 1949, which also occur in Brazil (Williams and Genoways 2008, Nogueira et al. 2014). *Lampronycteris* can be distinguished from *Micronycteris* by the lack of an interauricular band of skin connecting the ears (present in *Micronycteris*); from *Neonycteris* by the larger size (forearm > 35mm in *Lampronycteris*); from *Trinycteris* by the calcar equal or larger than foot, and for the ear larger than 16 mm; and from *Glyphonycteris* also by the calcar equal or larger than foot, and for shorter and narrower upper incisors (which are similar to canines in *Glyphonycteris* – Williams and Genoways 2008, Díaz et al. 2016, López-Baucells et al. 2016). The PECB specimen (ZSP 040; see Table 3 for measurements) has the diagnostic characters previously described for *L. brachyotis* (see Sanborn 1949, Medellín et al. 1985, Nogueira et al. 2007b, Williams and Genoways 2008), including: pointed ears lacking an interauricular band of skin; calcar slightly longer than foot; upper incisors shorter and in line with canines; dorsal fur bicolored, with pale-orange basis and orange-brown tips; head, throat and chest bright orange; the ventral fur pale orange with white regions caused by the absence of melanocytes (piebaldism); ears, wings and membranes dark brown (wings and membranes also presented some white spots).

**Distribution.** In Brazil the species occurs in the Amazon, Cerrado and Atlantic Forest biomes, in the states of Acre, Amazonas, Goiás, Rondônia, Pará, Tocantins, Piauí, Bahia, Espírito Santo, São Paulo, Mato Grosso, and Paraná (Tavares et al. 2008, Brandão et al. 2016, Reis et al. 2017). In São Paulo the species is known for two southern localities (Garbino 2016). This is the third record for the species in the state.

**Field observations.** The only specimen was captured in May. It is an adult non-reproductive female captured in a mist-net suspended 8 m over a small stream in sampling site M5 (Appendix 1).

##### *Micronycteris microtis* Miller, 1898

Fig. 5

**Taxonomy.** Eight species of *Micronycteris* Gray, 1866, occur in Brazil (Nogueira et al. 2014). They are divided in two groups: the “pale venter” species, which includes *M. brosetti* Simmons & Voss, 1998, *M. homezorum* Pirlot, 1967, *M. minuta* (Gervais, 1856), *M. sanborni* Simmons, 1966, and *M. schmidtorum*; and the “dark venter” species, including *M. hirsuta* (W. Peters, 1869), *M. megalotis* Gray, 1842, and *M. microtis* Miller, 1898. These groups can also be separated by the interauricular band height – high in most species of the “pale venter” group, and low in the “dark venter” group (Simmons et al. 2002). Specimens from PECB with ventral fur light brown (dark venter), similar to the dorsum in coloration, and low interauricular band, were identified as *M. microtis* (ZSP 011, 028; see Table 3 for measurements). The forearm length in this species is shorter than 35 mm, differing from *M. hirsuta* (forearm larger than 41 mm – Simmons et al. 2002, Williams and Genoways 2008, Díaz et al. 2016). *Micronycteris microtis* is distinguished from *M. megalotis* by the length of the ears (< 21 mm in *M. microtis*, and > 18.5 mm in *M. megalotis*); the length of the fur on lower third of marginal surface of pinna (< 3.9 mm in *M. microtis*, and > 4.1 mm in *M. megalotis*); and the length of dorsal fur over the upper back (< 11.3 mm in *M. microtis*, and > 9.1 mm in *M. megalotis* – Simmons and Voss 1998, Williams and Genoways 2008, Moras et al. 2015). Specimens from PECB have brownish pelage, with the dorsal fur bicolored, and a light brown basal band and mid brown distal band; ventral fur coloration is weakly bicolored, similar to the dorsal pelage. The measurements of specimens from PECB were all within the range of *M. microtis*: length of ears averaging 21.5 mm; length of the fur on pinna 3 mm; length of dorsal fur averaging 11 mm; and low interauricular band, with a shallow notch.

**Distribution.** In Brazil the species is recorded in Amazon, Cerrado and Atlantic Forest biomes, in the states of Amazonas, Pará, Amapá, Rondônia, Bahia, Rio de Janeiro, Espírito Santo, Minas Gerais, São Paulo and Mato Grosso (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is known only from four localities (Garbino 2016).

**Field observations.** We captured one adult male and one adult female of *M. microtis*, which were both taken in ground-level mist-nets in sampling sites M3 and M16 (Appendix 1). Captures occurred in October and February.

##### *Micronycteris schmidtorum* Sanborn, 1935

Fig. 6

**Taxonomy.** *Micronycteris schmidtorum* belong to the “pale venter” group, and can be distinguished from other pale venter species based on several morphological features. *Micronycteris schmidtorum* and *M. brosetti* are morphologically closer. Both present intermediate interauricular band with moderate notch, have the calcar longer than the hindfoot, and the dorsal fur larger than 7 mm, while in *M. minuta*, *M. homezorum* and *M.*





Figures 4–15. Bat species captured in Carlos Botelho State Park, São Paulo state, Brazil: (4) *Lamproncycteris brachyotis*; (5) *Micronycteris microtis*; (6) *Micronycteris schmidtorum*; (7) *Desmodus rotundus*; (8) *Diphylla ecaudata*; (9) *Mimon bennettii*; (10) *Trachops cirrhosus*; (11) *Anoura caudifer*; (12) *Anoura geoffroyi*; (13) *Glossophaga soricina*; (14) *Carollia perspicillata*; (15) *Glyphoncycteris sylvestris*.



*sanborni* the band is high and deep-notched, the calcar is equal or smaller than the hindfoot, and the dorsal fur is smaller than 7 mm (Simmons and Voss 1998, Williams and Genoways 2008). *M. schmidtorum* and *M. brosetti* can be distinguished based on tibia length (> 14.5 mm in *M. schmidtorum*, and <14.0 mm in *M. brosetti*) and fur length on outside of medial third of pinna (> 5 mm in *M. schmidtorum*, and < 4 mm in *M. brosetti* – Simmons and Voss 1998, Williams and Genoways 2008). The specimen from PECB (ZSP 013; see Table 3 for measurements) presented all the characters described for *M. schmidtorum*. The dorsal fur (ca 7.5 mm) is bicolored with light brown basis and nut-brown tips, the venter is tricolored with whitish basis and tips, and a brown mid band. The posterior surface of the forearm and the proximal third of the uropatagium are sparsely furred. Intermediate interauricular band with moderate notch. The calcar is larger than the foot, and fur length outside of medial third of pinna reaches 5.5 mm.

**Distribution.** The species was previously recorded in the Amazon, Caatinga, Cerrado and Atlantic Forest, in the states of Amapá, Amazonas, Pará, Tocantins, Mato Grosso, Maranhão, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, and Minas Gerais (Rocha et al. 2017a). Our specimen represents the first record of *M. schmidtorum* for São Paulo, extending the species distribution in more than 700 km southward from the southernmost locality, in the Parque Estadual do Rio Doce, Minas Gerais (Tavares and Taddei 2003) (Fig. 16).

**Field observations.** We captured one adult male in October, which was taken in a mist-net elevated 8 m over a wide trail in sampling site M4 (Appendix 1).

## Desmodontinae J.A. Wagner, 1840

### *Desmodus rotundus* (É. Geoffroy, 1810)

Fig. 7

**Taxonomy.** *Desmodus rotundus* is the only species in *Desmodus* Wied-Newied, 1826. Desmodontinae also includes other two species, *Diaemus youngii* (Jentink, 1893) and *Diphylla ecaudata* Spix, 1823 (Kwon and Gardner 2008), all occurring in Brazil. *Desmodus rotundus* can be distinguished from the other two by the presence of an elongated thumb with two rounded basal pads (*D. youngii* also presents an elongated thumb, but only one pad, while *D. ecaudata* presents a small thumb without pads). *Desmodus rotundus* also differs from *D. youngii* by the presence of a tiny calcar, which is absent in *D. youngii* (Kwon and Gardner 2008, López-Baucells et al. 2016). Specimens from PECB (ZSP 006, 031; see Table 3 for measurements) have dark brown dorsal fur, with whitish basis and dark brown tips, ventral fur bicolored, with a gray basis and whitish/silver tips, elongated thumb with two basal pads.

**Distribution.** In Brazil the species is recorded in all biomes and states (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is widely distributed, occurring in all the vegetational formations, and also in urban areas (Garbino 2016).

**Field observations.** We captured 18 individuals (5 males and 13 females) of *D. rotundus*, of which 16 were taken in February, March, April, June, July, August and October in ground-level mist-nets in sampling sites M2, M14, M16, M18, M19, M23, M24, M25, M29, M34, M36 and M39, in different elevations and

Table 3. Selected measurements (mm) and weight (g) for specimens of Micronycterinae and Desmodontinae from PECB, São Paulo state, Brazil. \* Mean values from Tavares and Taddei (2003) and Rocha et al. (2017). See Material and Methods for description of measurements.

Measurement	Micronycterinae					Desmodontinae			
	<i>Lamproncyteris brachyotis</i>	<i>Micronycteris microtis</i>		<i>Micronycteris schmidtorum</i>		<i>Desmodus rotundus</i>		<i>Diphylla ecaudata</i>	
	ZSP 040 ♀	ZSP 011 ♂	ZSP 028 ♀	ZSP 013 ♂ (PECB)	(Brazil)*	ZSP 006 ♀	ZSP 031 ♂	ZSP 039 ♂	ZSP 049 ♂
W	16.0	10.5	8.5	9.0	–	34.0	39.5	30.0	27.0
BL	60.66	50.94	41.28	49.52	42.80 (n = 2)	83.52	80.42	70.91	68.38
FA	41.50	34.11	34.93	35.56	33.95 (n = 4)	64.01	61.55	53.44	52.59
TL	16.96	14.88	15.46	17.67	–	28.44	27.62	21.92	21.97
EL	17.66	21.29	21.64	18.37	17.57 (n = 3)	17.67	19.66	13.45	13.46
TRL	5.90	6.93	6.28	5.73	–	6.74	7.33	6.97	5.52
GLS	21.81	18.79	18.30	20.13	19.07 (n = 4)	25.92	24.96	23.00	23.48
CI	19.68	16.38	16.19	17.62	–	23.11	21.96	20.41	20.77
BB	8.77	7.80	7.50	8.06	7.85 (n = 4)	13.00	12.45	11.50	11.38
ZB	10.76	8.76	8.80	9.18	8.93 (n = 3)	12.20	12.42	12.61	12.37
PB	5.02	3.91	3.91	4.41	4.20 (n = 3)	5.74	5.77	6.70	6.80
CC	3.99	3.07	3.11	3.36	3.17 (n = 4)	6.36	6.46	5.77	5.71
MB	9.03	7.52	7.48	7.96	8.62 (n = 4)	11.57	11.68	11.39	11.34
PL	10.61	9.14	8.57	9.67	–	10.21	9.55	7.48	7.66
MXTL	8.28	6.88	6.66	7.76	7.27 (n = 4)	3.73	3.62	3.54	3.67
MLTL	6.89	5.84	5.66	6.47	–	1.41	1.31	1.47	1.76
DL	14.79	11.86	11.64	12.52	11.96 (n = 3)	15.36	14.82	13.68	13.87
MNTL	9.42	7.57	7.62	8.24	7.57 (n = 4)	8.06	7.06	6.40	6.54
CH	5.15	3.65	3.69	4.61	–	6.37	6.00	4.53	4.56



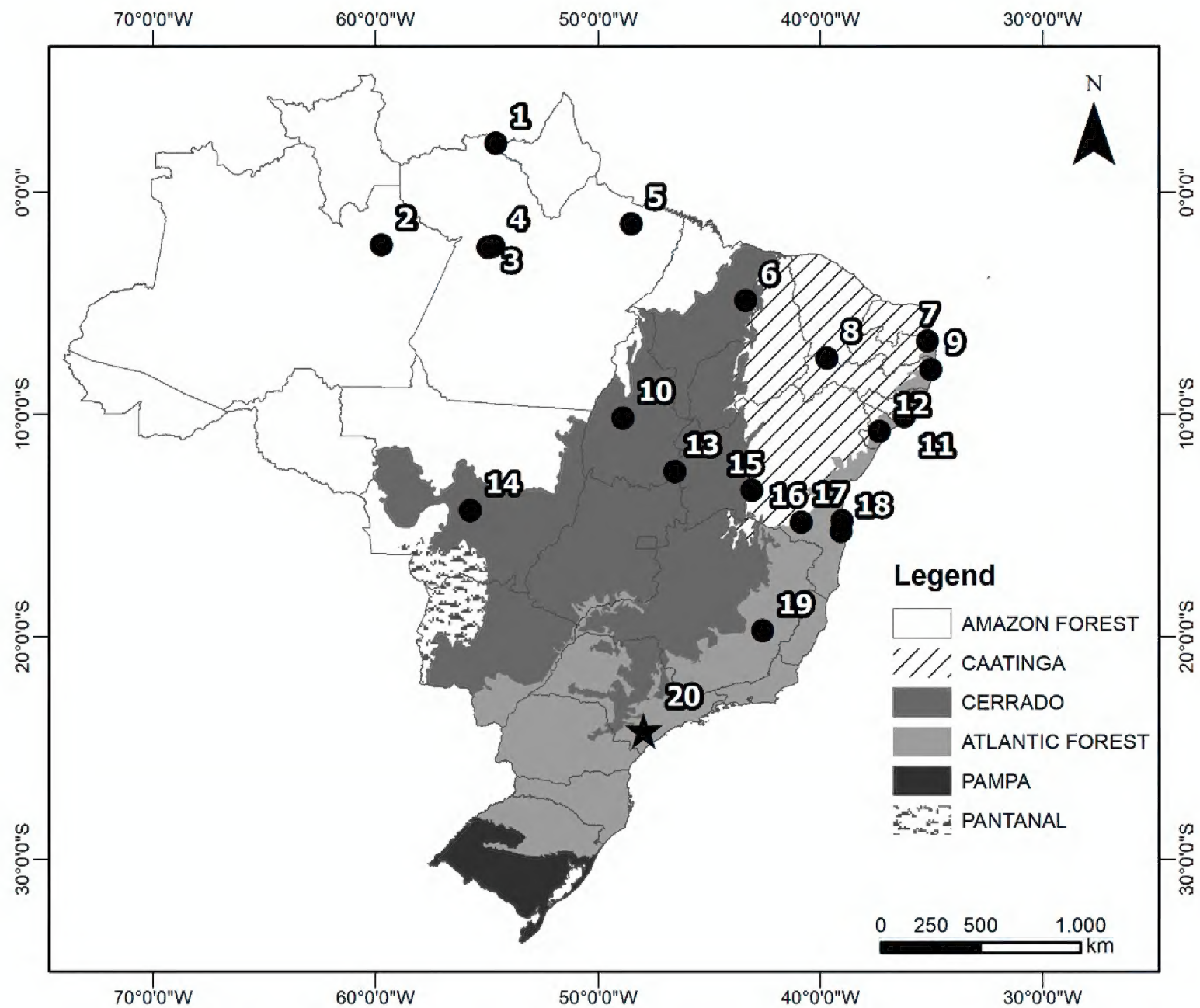


Figure 16. Distribution records of *Micronycteris schmidtorum* in Brazil. Black circles: previous occurrence records; black star: new record from the state of São Paulo. The numbers correspond to the records as indicated in the Table 4.

Table 4. Locality records of *Micronycteris schmidtorum* in Brazil. The map numbers correspond to the records as indicated in Fig. 16.

Map	Locality	Coordinates	Author
1	Parque Nacional Montanhas do Tumucumaque, Amapá	02°10.00'N, 54°34.00'W	Martins et al. (2006)
2	Manaus, Amazonas	02°24.00'S, 59°43.00'W	Bernard (2001)
3	Alter do Chão, Pará	02°30.00'S, 54°57.00'W	Bernard and Fenton (2002)
4	Santarém, Pará	02°27.00'S, 54°40.00'W	Bernard et al. (2001)
5	Belém, Pará	01°27.00'S, 48°30.00'W	Simmons (1996)
6	Inhamum Municipal Environmental Protection Area, Caxias, Maranhão	04°53.00'S, 43°22.00'W	Olímpio et al. (2016)
7	Reserva Biológica Guaribas, Paraíba	06°42.00'S, 35°11.00'W	Rocha et al. (2017a)
8	Exu, Pernambuco	07°30.00'S, 39°42.00'W	Ascorra et al. (1991a)
9	São Lourenço da Mata, Pernambuco	08°00.00'S, 35°01.00'W	Ascorra et al. (1991a)
10	Paraíso do Tocantins, Tocantins	10°10.00'S, 48°52.00'W	Nunes et al. (2005)
11	Reserva Particular do Patrimônio Natural (RPPN) Sitio Pau-Brasil, Cururipe, Alagoas	10°06.00'S, 36°13.00'W	Rocha et al. (2017a)
12	Parque Nacional Serra de Itabaiana, Areia Branca, Sergipe	10°46.00'S, 37°21.00'W	Rocha et al. (2017a)
13	Aurora do Tocantins, Tocantins	12°35.00'S, 46°32.00'W	Felix et al. (2016)
14	APA Cabeceiras do Rio Cuiabá, Rosário Oeste, Mato Grosso	14°19.00'S, 55°43.00'W	Louzada et al. (2015)
15	Médio Rio São Francisco, Bahia	13°25.00'S, 43°04.00'W	Sá-Neto and Marinho-Filho (2013)
16	Vitória da Conquista, Bahia	14°51.00'S, 40°51.00'W	Falcão et al. (2005)
17	Ilhéus, Bahia	14°46.00'S, 39°01.00'W	Faria et al. (2006)
18	Una, Bahia	15°16.00'S, 39°04.00'W	Faria et al. (2006)
19	Parque Estadual Rio Doce, Minas Gerais	19°44.00'S, 42°34.00'W	Tavares and Taddei (2003)
20	Carlos Botelho State Park, São Paulo	24°12.00'S, 47°56.00'W	This study



plant physiognomies; and two on June in a mist-net elevated 8 m in sampling site M33 (Appendix 1). Two lactating females were captured in June.

### *Diphylla ecaudata* Spix, 1823

Fig. 8

**Taxonomy.** This species can be separated from *D. rotundus* and *D. youngii* as described above and by presence of a shorter and well-furred uropatagium. *Diphylla ecaudata* also differs from *D. youngii* by the presence of a short calcar and absence of white tips on the wings (Kwon and Gardner 2008). Specimens from PECB (ZSP 039, 049; see Table 3 for measurements) presented a bicolored dorsal fur, with light brown basis and brown tips, bicolored venter, with light brown basis and grayish tips, forearm, legs and uropatagium furred, tiny calcar, reduced thumbs.

**Distribution.** In Brazil, the species is recorded in the Amazon, Atlantic Forest, Cerrado and Caatinga biomes, in the states of Amazonas, Acre, Rondônia, Pará, Amapá, Tocantins, Ceará, Pernambuco, Sergipe, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is distributed along the coastal Atlantic Forest (Garbino 2016).

**Field observations.** Three males and one female were captured in April, June, August and September in mist-nets set at ground-level in sampling sites M17, M25, M28 and M34 (Appendix 1).

### Phyllostominae Gray, 1825

#### *Mimon bennettii* (Gray, 1838)

Fig. 9

**Taxonomy.** *Mimon bennettii* (Gray, 1838) is the only species of *Mimon* (Gray, 1847) registered in Brazil (Hurtado and Pacheco 2014, Nogueira et al. 2014). The species most resembles *Gardneryceteris crenulatum* (É. Geoffroy, 1803) in the external morphology. The diagnosis of these species is based on the morphology of the noseleaf, which is smooth in *M. bennettii* and serrated in *G. crenulatum*, and the dorsal color, that is mid brown with lighter reddish venter and no dorsal stripe in *M. bennettii*, and dorsal fur dark brown with a single white stripe and yellowish brown ventral fur in *G. crenulatum* (see Ortega and Arita 1997, Nogueira et al. 2007b Hurtado and Pacheco 2014). The specimen from PECB (ZSP 041; see Table 5 for measurements) fits in the description of *M. bennettii*. The general coloration is reddish, and dorsal fur is bicolored, with mid brown basal band and reddish-brown distal band. The venter is weakly bicolored, with general reddish light brown coloration. The wings are attached along the tibia, the ears are pointed and well developed, and noseleaf is also well developed and smooth. The tail extends until the middle of the uropatagium.

**Distribution.** The species is recorded in all Brazilian biomes, except Pampas, occurring in the states of Amapá, Piauí,

Bahia, Mato Grosso, Mato Grosso do Sul, Goiás, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (Tavares et al. 2008, Reis et al. 2017). The type locality of the species is Ipanema, in São Paulo, where the species is distributed on the central, eastern and southeastern regions, including areas of dense ombrophilous forests, seasonal semideciduous forests, Cerrado, and transition areas (Garbino 2016).

**Field observations.** We captured one non-reproductive female in May, with a ground-level mist-net crossing a wide stream in sampling site M18 (Appendix 1).

### *Trachops cirrhosus* (Spix, 1823)

Fig. 10

**Taxonomy.** Monotypic, *T. cirrhosus* is easily distinguished from other members of Phyllostominae by the elongated papillae-like projections around the mouth (Lim and Engstrom 2001, Williams and Genoways 2008). The dorsal fur of the PECB specimens (ZSP 024; see Table 5 for measurements) is grayish brown, with light brown basis; the ventral fur is slightly lighter than dorsal fur, with whitish gray basis and gray tips. The ears are rounded and well developed, the tail reaches the middle of the interfemoral membrane and the margins of noseleaf are serrated.

**Distribution.** In Brazil the species occurs in all biomes, except Pampas, with records in the states of Amazonas, Acre, Rondônia, Roraima, Pará, Amapá, Tocantins, Mato Grosso, Mato Grosso do Sul, Goiás, Paraná, São Paulo, Rio de Janeiro, Minas Gerais, Espírito Santo, Bahia, Sergipe, Alagoas, Pernambuco, Paraíba, Ceará, and Piauí (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is distributed along the coastal Atlantic Forest (Garbino 2016).

**Field observations.** We captured two males and one female of *T. cirrhosus*, which were taken in ground-level mist-nets in sampling sites M4, M10 and M16 (Appendix 1). Captures occurred in January and February, with one lactating female captured on January.

### Glossophaginae Bonaparte, 1845

#### *Anoura caudifer* (É. Geoffroy, 1818)

Fig. 11

**Taxonomy.** *Anoura* Gray, 1838 is represented in Brazil by *A. caudifer* (É. Geoffroy, 1818) and *A. geoffroyi* Gray, 1838 (Nogueira et al. 2014). The two species are distinguished by external characters: *A. caudifer* is smaller (forearm < 39 mm in *A. caudifer*, > 39 mm in *A. geoffroyi*); the tail is present in *A. caudifer*, although reduced and sometimes not visible (always absent in *A. geoffroyi*); uropatagium is narrow with a central fringe in *A. caudifer* (very reduced and well furred with the fur reaching the feet in *A. geoffroyi*) (Mantilla-Meluk and Baker 2006, Nogueira et al. 2007a, Díaz et al. 2016). Specimens from PECB (ZSP 001, 012; see Table 5 for measurements) presented bicolored dorsal fur, with pale basis and brown tips; ventral fur lighter than dorsum,



Table 5. Selected measurements (mm) and weight (g) for specimens of Phyllostominae, Glyphonycterinae and Glossophaginae from PECB, São Paulo state, Brazil. See Material and Methods for description of measurements.

Measurement	Phyllostominae		Glyphonycterinae		Glossophaginae				
	<i>Mimon bennettii</i>	<i>Trachops cirrhosus</i>	<i>Glyphonycteris sylvestris</i>		<i>Anoura caudifer</i>		<i>Anoura geoffroyi</i>		<i>Glossophaga soricina</i>
	ZSP 041 ♀	ZSP 024 ♂	ZSP 033 ♂	ZSP 042 ♂	ZSP 001 ♂	ZSP 012 ♀	ZSP 014 ♀	ZSP 057 ♂	ZSP 060 ♂
W	22.0	32.0	18.0	12.0	12.0	12.0	22.0	17.5	10.5
BL	65.83	74.32	52.12	55.39	61.22	53.32	69.79	63.05	54.13
FA	57.29	57.89	40.96	43.30	38.18	36.17	42.00	42.23	36.92
TL	24.77	25.55	15.02	15.98	13.87	14.00	16.20	15.52	15.64
EL	35.30	27.20	17.89	15.87	13.86	12.57	14.33	15.87	15.35
TRL	13.99	10.27	6.38	7.31	4.70	5.77	4.98	5.57	5.99
GLS	25.55	28.08	20.96	22.01	23.00	22.52	26.23	25.52	21.06
CI	22.86	24.69	19.17	19.94	22.28	21.81	25.51	24.64	19.93
BB	9.77	11.23	9.11	9.36	9.51	8.92	9.95	9.95	8.85
ZB	13.52	13.31	10.34	10.62	10.03	9.52	11.20	11.30	9.84
PB	4.71	5.18	5.01	5.01	4.78	4.49	5.19	5.26	4.90
CC	5.40	5.75	3.52	3.77	4.52	4.20	4.61	4.86	3.90
MB	10.53	11.69	8.62	8.93	8.94	8.68	10.10	9.80	8.78
PL	12.75	11.22	9.86	10.39	12.81	12.41	15.26	14.20	11.53
MXTL	9.56	10.20	8.30	8.77	8.41	8.32	10.23	9.50	7.40
MLTL	8.01	8.19	6.63	7.27	7.25	7.03	8.54	7.46	5.51
DL	17.14	18.19	13.60	14.50	16.83	16.35	19.20	17.83	14.43
MNTL	10.89	11.40	9.18	10.05	9.35	8.77	11.30	10.53	8.32
CH	5.92	4.97	3.81	4.19	4.27	3.64	4.57	4.90	4.26

Table 6. Selected measurements (mm) and weight (g) for specimens of Carolliinae and Stenodermatinae from PECB, São Paulo state, Brazil. See Material and Methods for description of measurements.

Measurement	Carolliinae		Stenodermatinae							
	<i>Carollia perspicillata</i>		<i>Pygoderma bilabiatum</i>		<i>Artibeus fimbriatus</i>		<i>Artibeus lituratus</i>		<i>Artibeus obscurus</i>	
	ZSP 022 ♂	ZSP 045 ♂	ZSP 043 ♂	ZSP 044 ♂	ZSP 027 ♀	ZSP 037 ♂	ZSP 015 ♀	ZSP 056 ♂	ZSP 009 ♂	ZSP 025 ♀
W	15.0	19.0	18.0	16.0	48.0	49.5	64.5	65.0	39.0	43.0
BL	59.93	55.65	59.60	59.22	81.02	81.61	94.72	88.37	77.50	77.82
FA	39.07	42.25	37.91	37.19	67.61	64.71	68.04	70.29	57.11	58.01
TL	16.99	16.34	19.82	21.16	28.72	27.05	30.06	26.61	22.94	21.16
EL	19.51	17.23	18.83	18.95	19.85	23.00	19.13	22.67	21.59	21.88
TRL	6.77	6.53	6.99	6.80	4.90	7.18	6.32	7.78	7.32	6.59
GLS	22.06	22.32	20.42	20.46	31.28	32.10	32.60	31.82	27.79	28.26
CI	19.97	20.41	17.57	17.40	28.06	28.53	28.95	28.22	25.00	25.73
BB	9.19	9.54	10.66	10.31	13.40	13.32	13.64	13.70	12.45	12.38
ZB	10.80	11.12	13.85	13.72	18.33	19.03	19.75	18.30	16.64	17.06
PB	5.32	5.46	7.94	7.85	7.35	7.69	7.86	6.54	6.69	6.38
CC	4.87	4.93	6.16	6.08	9.08	8.95	9.35	8.47	7.73	7.44
MB	9.35	9.75	11.04	10.75	14.44	14.93	15.62	14.82	13.44	13.33
PL	10.37	10.22	6.59	6.83	15.78	16.15	16.04	15.90	14.02	14.40
MXTL	7.28	7.38	5.49	5.62	11.27	11.92	11.94	11.06	10.41	10.36
MLTL	5.78	5.91	4.49	4.59	9.68	10.08	10.14	9.42	8.89	8.86
DL	13.99	14.45	12.02	12.03	21.61	21.41	21.87	21.83	19.55	19.69
MNTL	8.57	8.56	5.79	6.00	13.55	13.49	13.67	13.05	11.87	11.19
CH	5.38	5.28	4.36	4.53	9.14	8.83	9.89	10.03	8.06	7.91

mid brown and almost unicolored; uropatagium with a central fringe of dense hairs; and tail visible.

Distribution. In Brazil the species is recorded in all biomes, except Caatinga, occurring in the states of Acre, Amazonas, Amapá, Bahia, Espírito Santo, Goiás, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Pará, Paraná, Rio de Janeiro, Rio Grande do

Sul, Santa Catarina, and São Paulo (Tavares et al. 2008, Reis et al. 2017). The species is widely distributed in São Paulo, occurring in all vegetational formations (Garbino 2016).

Field observations. We recorded 41 specimens, 20 of which (12 males and 8 females) were taken in ground-level mist-nets in sampling sites M3, M4, M6, M7, M11, M16, M19, M20, M21,



M22, M23, M25, M27, M29 and M38; six (1 male and 5 females) were taken at mist-nets elevated 8 m in sampling sites M5 and M9; and 15 were captured inside a culvert in sampling site S1 (Appendix 1). Captures occurred in October, November, December, February, April, May, July, August and September. Lactating females were captured in May, October and December, and pregnant females were caught in August, September, October, November and December.

### *Anoura geoffroyi* Gray, 1838

Fig. 12

**Taxonomy.** The diagnosis of *A. geoffroyi* is described above. Specimens from PECB (ZSP 014, 057; see Table 5 for measurements) have a dark brown dorsal fur, with pale basis, and grayish and unicolored venter; uropatagium well furred, with hairs reaching the feet; and tail absent.

**Distribution.** In Brazil, the species is recorded in all biomes, in the states of Amapá, Bahia, Ceará, Espírito Santo, Goiás, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Pará, Paraíba, Pernambuco, Piauí, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, Tocantins, and São Paulo (Tavares et al. 2008, Solari 2016, Reis et al. 2017). In São Paulo, the species is recorded in the north, central and southeastern regions (Garbino 2016).

**Field observations.** We recorded 28 specimens, 22 of which (5 males and 17 females) were taken in ground-level mist-nets in the sampling sites M4, M6, M7, M17, M20, M21, M23, M26 and M32; and six (2 males and 4 females) at mist-nets elevated 8 m in sampling sites M5, M6, M7, M20 and M31 (Appendix 1). Captures occurred in October, November, March, April, May, August and September; pregnant females were caught in September, October and November.

### *Glossophaga soricina* (Pallas, 1766)

Fig. 13

**Taxonomy.** Three species of *Glossophaga* É. Geoffroy, 1818 occur in Brazil: *G. commissarisi* Gardner, 1962, *G. longirostris* Miller, 1898, and *G. soricina* (Pallas, 1766) (Nogueira et al. 2014). The diagnosis is based mainly on tooth morphology: *G. soricina* and *G. longirostris* can be distinguished from *G. commissarisi* by the position and shape of incisors; lower incisors are larger and usually in contact, forming a complete arc between canines in the first two species, and reduced with distinct gaps between them in *G. commissarisi*; upper incisors greatly procumbent in the first two, and not procumbent in *G. commissarisi*. *Glossophaga soricina* has inner upper incisors larger than the outer in occlusal view and spatulated lower incisors while *G. longirostris* has inner upper incisors about the same size of the outer and large and weakly cusped lower incisors (Webster 1993, Nogueira et al. 2007a, López-Baucells et al. 2016). Specimens from PECB (ZSP 060; see Table 5 for measurements) fit in the description of *G. soricina* and have a bicolored dorsal fur, with light brown basis and nut-brown tips, bicolored ventral fur with light brown basis

and nut-brown tips. The rostrum is short and the lower lip is grooved and surrounded by small warts.

**Distribution.** In Brazil, the species is recorded in all biomes and states (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is also widely distributed, occurring in all vegetational formations (Garbino 2016).

**Field observations.** We captured one adult male in September in a building roof, in sampling site S17 (Appendix 1). We captured one *M. rufus* in the same roost.

### Caroliinae Miller, 1924

#### *Carollia perspicillata* (Linnaeus, 1758)

Fig. 14

**Taxonomy.** *Carollia* Gray, 1838 is represented in Brazil by *C. benkeithi* Solari & Baker, 2006, *C. brevicauda* (Schinz, 1821) and *C. perspicillata* (Linnaeus, 1758) (Nogueira et al. 2014). The forearm is usually dorsally furred and can reach 45 mm in *C. perspicillata* and 42 mm in *C. brevicauda*, and is naked and shorter than 39 mm in *C. benkeithi*; the dorsal fur have a marked banding in *C. perspicillata* and *C. brevicauda*, and lacks a sharply defined banding in *C. benkeithi*; and the ventral fur is unicolored in *C. perspicillata* and slightly bicolored in *C. brevicauda*, while it is short with brown-tipped bicolored hairs in *C. benkeithi* (Allen 1890, Cloutier and Thomas 1992, Simmons and Voss 1998, Solari and Baker 2006, López-Baucells et al. 2016, Ruelas 2017). The effectiveness of the diagnostic characters between *C. perspicillata* and *C. brevicauda*, both with records in Southeastern Brazil, are still discussed (Dias and Peracchi 2008, Ruelas 2017). Despite of some variations reported in the literature, useful characters to separate these species are: dorsal fur short in *C. perspicillata* (5.0–7.0 mm) and longer in *C. brevicauda* (7.0–8.6 mm); dorsal fur tricolored in *C. perspicillata* and tetracolored in *C. brevicauda*; forearm sparsely haired in *C. perspicillata* and densely haired in *C. brevicauda*; and tibia length larger than 14 mm in *C. perspicillata* and smaller than 16 mm in *C. brevicauda* (see Pine 1972, Cloutier and Thomas 1992, Ruelas 2017, Thomas 2017, Lemos et al. 2020).

Specimens from PECB (ZSP 008, 022, 023, 045; see Table 6 for measurements) have well-marked tetracolored dorsal fur, with light brown basal bands (ca 10% of the fur length), followed by a large dark brown band, a light brown band and dark brown tips; the venter is lighter and unicolored (Fig. 17). The well-marked tetracolored dorsal fur diverge from the characters observed by other authors for the species (Pine 1972, Cloutier and Thomas 1992, Dias and Peracchi 2008, Ruelas 2017, Lemos et al. 2020), but the tibia length (averaging 16.8 mm), the dorsal fur length (averaging 6.8 mm), sparsely furred thumb and forearm, and skull features and measurements (Table 6) conforms to previous descriptions of *C. perspicillata*.

**Distribution.** In Brazil the species is widely distributed, recorded in all biomes and states (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is widely distributed, occurring in all the vegetational formations (Garbino 2016).





Figure 17. Tetracolored banding pattern on the dorsal fur of a specimen of *Carollia perspicillata* captured in the Carlos Botelho State Park, São Paulo, Brazil.

Field observations. We captured 95 individuals (51 males and 44 females), all of them were taken at ground-level mist-nets in sampling sites M3, M4, M5, M6, M10, M13, M14, M16, M17, M18, M19, M20, M21, M22, M23, M24, M25, M27, M28, M31, M33 and M34 (Appendix 1). Captures occurred in all months except July and December. We recorded lactating females in February, May and November; pregnant females in January, April, September and October; and juveniles in January, February, March, April, May and June.

### Glyphonycterinae Baker, Solari, Cirranello & Simmons, 2016

#### *Glyphonycteris sylvestris* Thomas, 1896

Fig. 15

Taxonomy. *Glyphonycteris* Thomas is represented in Brazil by *G. behnii* (Peters, 1856), *G. daviesi* (Hill, 1965) and *G. sylvestris* Thomas, 1896 (Nogueira et al. 2014). The validity of *G. sylvestris* is still debatable, once Simmons and Voss (1998) suggested that *G. behnii* could be a senior synonym of *G. sylvestris* based on results obtained by Simmons (1996), which examined two specimens from Peruvian Amazonia referred as *G. behnii* and concluded that forearm and skull measurements of those specimens overlap the values registered for *G. sylvestris*. Gregorin et al. (2011b), however, suggests that if the estimates of Simmons (1996) on forearm length of the Peruvian specimens recorded by Andersen (1906) are correct, these specimens should be considered *G. sylvestris* with occurrence restricted to

tropical forest environments and *G. behnii* would be restricted to Brazilian Cerrado – the type locality of the species (Cuiabá, Mato Grosso state). *Glyphonycteris daviesi* is the larger species in the genus and can be separated by the larger forearm length (> 52 mm in *G. daviesi*, < 44 mm in *G. sylvestris* and between 44 and 47 mm in *G. behnii*); presence of one pair of upper incisors while the other species have two pairs; and by the unicolored dorsal fur, that is tricolored in the other two species (Simmons and Voss 1998, Nogueira et al. 2007b, Williams and Genoways 2008). *Glyphonycteris sylvestris* can be separated from *G. behnii* by forearm length and skull measurements (FA < 44 mm, GLS < 22 mm in *G. sylvestris*, and FA > 44 mm GLS > 21 mm in *G. behnii* – Williams and Genoways 2008, Gregorin et al. 2011b). Specimens from PECB (ZSP 033, 042; see Table 5 for measurements) have tricolored dorsal fur, with gray basal band, followed by a pale gray mid band and dark gray tips, bicolored ventral fur with a gray basal band and light gray distal band. Ears are medium-size and pointed, the tail does not reach the edge of interfemoral membrane, and calcar is smaller than foot. Incisors chisel-shaped resemble canines on size; and premolars of same size with tips slightly recurved.

Distribution. In Brazil the species is recorded in the Amazon, Cerrado and Atlantic Forest, occurring in the states of Amazonas, Amapá, Minas Gerais, Pará, Paraná, Rio de Janeiro, Roraima, São Paulo, and Tocantins (Felix et al. 2016, Reis et al. 2017). In São Paulo, the species is recorded in only two localities, in south and southeastern regions (Garbino 2016).

Field observations. We captured two adult males, in March and May, in mist-nets elevated 8 m over a wide stream, in sampling sites M18 and M24 (Appendix 1).

### Stenodermatinae P. Gervais, 1856

#### *Artibeus fimbriatus* Gray, 1838

Fig. 18

Taxonomy. Five species of *Artibeus* Leach, 1821 are found in Brazil: *A. concolor* Peters, 1865, *A. fimbriatus* Gray, 1838, *A. lituratus* (Olfers, 1818), *A. obscurus* (Schinz, 1821) and *A. planirostris* (Spix, 1832) (Nogueira et al. 2014). *Artibeus concolor* is comparatively smaller (forearm < 53 mm in *A. concolor*, and > 55 mm in the other species), and with tricolored dorsal fur (bicolored in the congeners) (Zórtea 2007, Marques-Aguiar 2008, Díaz et al. 2016). The field identification of the species of *Artibeus* captured in PECB was based on a set of external characters provided by Koepcke and Kraft (1984), Marques-Aguiar (1994), Lim and Engstrom (2001), Haynes and Lee Jr (2004), Hollis (2005), Zortéa (2007), Marques-Aguiar (2008), Dias and Peracchi (2008) and Araújo and Langguth (2010), such as: base of noseleaf (attached or separate from upper lip), brightness of facial stripes, presence/absence of fur on the dorsal side of forearm, corporal size, presence/absence of fur on the dorsal side of uropatagium, presence/absence of ventral frosting and length of dorsal fur. *Artibeus fimbriatus* can be distinguished from *A.*



*lituratus* by the presence of sparse hairs on the dorsal side of the uropatagium, which is densely furred on *A. lituratus*, presence of ventral frosting (absent in *A. lituratus*), weakly marked facial stripes (brilliant and well markedwell-marked in *A. lituratus*), longer dorsal fur, close to 8 mm (6–8 mm in *A. lituratus*), and sparse hairs on the dorsal side of the forearm, which is densely furred in *A. lituratus* (Koepcke and Kraft 1984, Marques-Aguiar 1994, 2008 Haynes and Lee Jr 2004, Dias and Peracchi 2008, Araújo and Langguth 2010).

*Artibeus fimbriatus* can be distinguished from *A. planirostris* by its larger size, the presence of sparse hairs on the dorsal side of the uropatagium and forearm (almost naked in *A. planirostris*), by the base of the noseleaf attached to the upper lip (separated in *A. planirostris*), and longer dorsal fur, close to 8 mm (6–8 mm in *A. planirostris* – Koepcke and Kraft 1984, Marques-Aguiar 1994, 2008, Haynes and Lee Jr 2004, Hollis 2005). *Artibeus fimbriatus* and *A. obscurus* differ in size (larger forearm in *A. fimbriatus*); the length of dorsal fur (close to 8 mm in *A. fimbriatus* and 8–10 mm in *A. obscurus*); base of the noseleaf attached to the upper lip in *A. fimbriatus* (totally separated in *A. obscurus*); presence of sparse hairs on the dorsal side of the uropatagium in *A. fimbriatus* (almost naked on *A. obscurus*); ventral frosting more evident in *A. obscurus*; and presence of sparse hairs on the dorsal side of the forearm in *A. fimbriatus* (densely furred on *A. obscurus* – Marques-Aguiar 1994, 2008, Haynes and Lee Jr 2004, Dias and Peracchi 2008, Araújo and Langguth 2010).

The PECB specimens (ZSP 027, 037; see Table 6 for measurements) identified as *A. fimbriatus* have bicolored dorsal fur, with pale brown basis and grayish brown tips, and ventral fur weakly bicolored, with pale basis and frosted tips. Dorsal fur averaging 8.5 mm (7.9–9.3 mm), the forearm and uropatagium are sparsely furred, the noseleaf is attached to the upper lip, the ears and tragus are brown, and the facial stripes are poorly marked.

**Distribution.** In Brazil, the species is recorded in all biomes, except Amazon, occurring in Distrito Federal and in the states of Ceará, Pernambuco, Sergipe, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Mato Grosso do Sul, Paraná, Santa Catarina, Rio Grande do Sul, Paraíba and Maranhão (Reis et al. 2013, Oliveira and Aguiar 2015, Olímpio et al. 2016, Zeppelini et al. 2016). In São Paulo, the species is recorded in the central, south and southeastern regions (Garbino 2016).

**Field observations.** We recorded 46 specimens, 37 of which (14 males and 23 females) were taken in ground-level mist-nets set in sampling sites M7, M14, M16, M18 M20, M21, M24, M26, M27, M28, M32, M35, M36 and M38; eight (4 males and 4 females) in mist-nets elevated 8 m in sampling sites M14, M24, M26, M28 and M31; and one adult female on a building roof, in sampling site S2 (Appendix 1). Captures occurred in November, February, March, April, May, June, July and September. Lactating females were netted in February, March and July; pregnant females in February, March and November; and juveniles in February, March, April, May and July.

## *Artibeus lituratus* (Olfers, 1818)

Fig. 19

**Taxonomy.** The distinction between *A. lituratus* and *A. fimbriatus* is discussed above. *A. lituratus* can be externally distinguished from *A. planirostris* and *A. obscurus* by its larger size; well-marked facial stripes (poorly marked to absent on the other two); lack of ventral frosting (present on the other two species); base of the noseleaf attached to the upper lip, while is always separated in *A. planirostris* and in some *A. obscurus*; and dorsal side of the uropatagium densely furred, which is almost naked in *A. planirostris* and *A. obscurus*. *Artibeus lituratus* can also be distinguished from *A. planirostris* by the presence of dense fur on the dorsal side of the forearm (almost naked in *A. planirostris*). Additionally, *A. lituratus* has short dorsal fur (6–8 mm), which is longer in *A. obscurus* (8–10 mm – Koepcke and Kraft 1984, Marques-Aguiar 1994, 2008, Haynes and Lee Jr 2004, Hollis 2005, Zortéa 2007, Dias and Peracchi 2008, Araújo and Langguth 2010). The PECB specimens (ZSP 015, 056; see Table 6 for measurements) identified as *A. lituratus* have bicolored dorsal fur, with grayish brown basal band and chocolate brown tips; ventral fur weakly bicolored with pale brown basis and grayish tips, frosting absent. Uropatagium and forearm are densely furred, the facial stripes are bright and well markedwell-marked, the edge of ears and tragus are yellowish, the dorsal fur ranges from 7.7 to 8.9 mm in lengthlength and the noseleaf base is attached to the upper lip.

**Distribution.** In Brazil, the species is recorded in all biomes and states (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is also widely distributed, occurring in all the vegetational formations (Garbino 2016).

**Field observations.** We captured 10 specimens, seven of which (4 males and 3 females) were taken in ground-level mist-nets in sampling sites M6, M18, M19, M21, M22 and M32; and three (1 male and 2 females) in mist-nets elevated 8 m in sampling sites M15, M20 and M24 (Appendix 1). Captures occurred in November, January, February, March, May and September. We netted lactating females in January, March and November; and juveniles in September.

## *Artibeus obscurus* (Schinz, 1821)

Fig. 20

**Taxonomy.** The distinction of *A. obscurus* from *A. lituratus* and *A. fimbriatus* is discussed above. *Artibeus obscurus* and *A. planirostris* are similar in size and can be externally distinguished using the length of dorsal fur (8–10 mm in *A. obscurus*, 6–8 mm in *A. planirostris*), fur on the dorsal side of the forearm (densely furred in *A. obscurus* and almost naked in *A. planirostris*), and a more strong ventral frosting in *A. obscurus*, which is usually darker than *A. planirostris* (Koepcke and Kraft 1984, Marques-Aguiar 1994, 2008, Haynes and Lee Jr 2004, Hollis 2005, Dias and Peracchi 2008, Araújo and Langguth 2010). The PECB specimens (ZSP 009, 025; see Table 6 for measurements) identified as *A. obscurus*





Figures 18–29. Bat species captured in Carlos Botelho State Park, São Paulo state, Brazil: (18) *Artibeus fimbriatus*; (19) *Artibeus lituratus*; (20) *Artibeus obscurus*; (21) *Dermanura cinerea*; (22) *Platyrrhinus lineatus*; (23) *Platyrrhinus recifinus*; (24) *Pygoderma bilabiatum*; (25) *Sturnira lilium*; (26) *Sturnira tildae*; (27) *Vampyressa pusilla*; (28) *Cynomops abrasus*; (29) *Molossops neglectus*.



presented bicolored dorsal fur with pale brown basis and grayish dark brown tips, and ventral fur weakly bicolored, with pale basis and frosted tips. Dorsal fur averaging 11 mm (10.35–11.8 mm), forearm densely furred, uropatagium sparsely furred, the base of noseleaf usually free (sometimes attached only at the central portion), ears and tragus are brownish, the facial stripes are poorly marked and a dark mask is present around the eyes.

**Distribution.** In Brazil, the species is recorded in all the biomes except Pampas, in the states of Amazonas, Acre, Rondônia, Pará, Amapá, Roraima, Ceará, Piauí, Paraíba, Pernambuco, Sergipe, Bahia, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (Reis et al. 2013, Sampaio et al. 2016). In São Paulo, the species is distributed along the coastal Atlantic Forest (Garbino 2016).

**Field observations.** We recorded 31 captures, of which 27 (10 males and 17 females) were taken in mist-nets set at ground-level in the sampling sites M3, M4, M5, M16, M18, M21, M22, M23, M24, M25, M27, M28, M37 and M38, and four females in mist-nets elevated 8 m in the sampling sites M5, M18, M24 and M28 (Appendix 1). Captures occurred in October, January, February, March, April, May, July, August and September. We captured lactating females in January, February, April, May and July; pregnant females in May and August; and juveniles in January and April.

### *Dermanura cinerea* Gervais, 1856

Fig. 21

**Taxonomy.** Four species of *Dermanura* Gervais, 1856 are found in Brazil: *D. anderseni* (Osgood, 1916), *D. bogotensis* (Andersen, 1906), *D. cinerea* Gervais, 1856, and *D. gnoma* (Handley, 1987) (Nogueira et al. 2014). *Dermanura gnoma* can be separated from the other three species by the presence of a third lower molar (two in the other species) (Simmons and Voss 1998, Marques-Aguiar 2008, Lim and Engstrom 2001, Díaz et al. 2016). *D. cinerea* has the dorsal side of the uropatagium almost naked, without hairs extending beyond the posterior edge, while in *D. anderseni* and *D. bogotensis* it is conspicuously furred and the hairs extending beyond the posterior edge (Gonçalves and Gregorin 2004, Marques-Aguiar 2008, Lim et al. 2008, Calderón and Pacheco 2012, Díaz et al. 2016, Reis et al. 2017, Rocha et al. 2017b). Specimens from PECB (ZSP 035, 036; see Table 7 for measurements) presented bicolored dorsal fur with mid brown basis and dark brown tips, bicolored ventral fur with light brown basis and grayish brown tips, uropatagium almost naked with a shallow notch, and yellowish brown to bright yellow noseleaf and ear edges.

**Distribution.** In Brazil, the species is recorded in the Amazon, Atlantic Forest, Caatinga and Cerrado biomes, in the states of Amazonas, Acre, Rondônia, Pará, Amapá, Roraima, Tocantins, Maranhão, Piauí, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Mato Grosso, Minas Gerais, Goiás, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (Reis et al. 2013), with

many records pending review (Reis et al. 2017). In São Paulo state, the species is recorded only in three locations of the coastal Atlantic Forest (Garbino 2016).

**Field observations.** One of the eight (5 males and 3 females) individuals was captured in a mist-net elevated 8 m over a stream in sampling site M27, and the other seven were taken in mist-nets set at ground-level in the sampling sites M21, M22, M23, M25, M27 and M28 (Appendix 1). Captures occurred in April, August and September. One pregnant female was captured in August.

### *Platyrrhinus lineatus* (É. Geoffroy, 1810)

Fig. 22

**Taxonomy.** In Brazil, *Platyrrhinus* Saussure, 1860 is represented by eight species: *P. angustirostris* Velazco, Gardner & Patterson, 2010, *P. aurarius* (Handley & Ferris, 1972), *P. brachycephalus* (Rouk and Carter, 1972), *P. fusciventris* Velazco, Gardner & Patterson, 2010, *P. incarum* (Thomas, 1912), *P. infuscus* (Peters, 1880), *P. lineatus* (É. Geoffroy, 1810) and *P. recifinus* (Thomas, 1901) (Nogueira et al. 2014). According to Gardner (2008b), Velazco et al. (2010) and Díaz et al. (2016), *P. lineatus* and *P. recifinus* have intermediate size within the genus and are distinguished from the small species by the forearm size (> 42 mm in *P. lineatus* and *P. recifinus* and < 42 mm in *P. angustirostris*, *P. brachycephalus*, *P. fusciventris* and *P. incarum*). *Platyrrhinus infuscus* and *P. aurarius*, with records in Brazil restricted to Amazon, are larger than *P. lineatus* and *P. recifinus* (forearm > 49 mm in *P. aurarius*, >54 mm in *P. infuscus* and <48 mm in *P. lineatus* and *P. recifinus*).

The distinction between *P. lineatus* and *P. recifinus* is based on several characters, such as: presence of one interramal vibrissae in *P. lineatus*, absent in *P. recifinus*; tricolored dorsal fur in *P. lineatus*, tetracolored in *P. recifinus*; larger size in *P. lineatus* (forearm > 45 mm, < 46 mm in *P. recifinus*); lower incisors bilobed in *P. lineatus*, trilobed or flat in *P. recifinus* (Velazco 2005, Dias and Peracchi 2008, Velazco et al. 2010, Díaz et al. 2016). The specimen from PECB (ZSP 032; see Table 7 for measurements) have a tricolored dorsal fur, with a narrow mid-brown basal band, a paler mid band and a mid-brown distal band; ventral fur is light brown. Facial and dorsal stripes are bright and well marked, uropatagium has a deep notch and furred edge. Edge of the ears and noseleaf are whitish and one interramal vibrissae is present. Upper inner incisors in contact, and lower incisors in contact, well developed and bilobed.

**Distribution.** In Brazil, the species is recorded in all biomes, in the states of Tocantins, Piauí, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul (Velazco 2005, Reis et al. 2013). In São Paulo the species is widely distributed, occurring in all the vegetational formations (Garbino 2016).

**Field observations.** In March we captured one adult female in a mist-net elevated 8 m over a wide stream in sampling site M24 (Appendix 1).



Table 7. Selected measurements (mm) and weight (g) for specimens of Stenodermatinae from PECB, São Paulo state, Brazil. See Material and Methods for description of measurements.

Measurement	Stenodermatinae							
	<i>Dermanura cinerea</i>		<i>Platyrrhinus lineatus</i>	<i>Platyrrhinus recifinus</i>	<i>Sturnira lilium</i>	<i>Sturnira tildae</i>		<i>Vampyressa pusilla</i>
	ZSP 035 ♀	ZSP 036 ♀	ZSP 032 ♀	ZSP 055 ♂	ZSP 002 ♂	ZSP 029 ♀	ZSP 038 ♀	ZSP 058 ♂
W	14.0	13.0	23.0	20.0	21.0	23.0	–	9.0
BL	55.57	54.22	58.09	62.26	62.70	63.75	66.43	50.69
FA	40.15	40.69	44.82	42.51	44.20	46.61	45.29	34.48
TL	16.33	15.70	18.03	16.01	18.56	19.66	18.55	12.91
EL	12.89	13.16	16.26	14.75	14.40	18.40	18.38	13.99
TRL	5.21	5.34	5.15	5.42	6.24	5.43	6.36	5.19
GLS	20.46	21.04	24.77	25.10	23.89	24.41	23.51	20.10
CI	18.44	18.42	22.31	23.18	21.35	21.97	21.05	18.46
BB	9.59	9.02	10.43	10.71	10.71	10.60	10.82	8.75
ZB	12.51	11.65	14.33	14.69	14.36	14.74	14.51	11.72
PB	4.68	4.49	5.43	5.92	6.11	6.18	5.98	5.05
CC	5.78	5.33	6.26	6.31	6.29	6.17	5.62	4.89
MB	10.12	9.50	11.33	11.93	11.29	11.36	11.43	9.54
PL	10.00	9.99	12.29	12.50	10.27	10.75	10.69	9.60
MXTL	6.56	6.75	9.33	9.42	6.83	7.00	6.81	6.83
MLTL	5.79	5.89	7.84	7.86	5.39	5.61	5.57	5.38
DL	12.97	13.23	16.93	17.44	15.62	15.60	15.23	12.76
MNTL	7.05	7.35	10.60	10.45	8.51	7.88	7.76	7.33
CH	5.01	5.45	5.96	5.99	6.12	6.02	5.82	4.26

### *Platyrrhinus recifinus* (Thomas, 1901)

Fig. 23

**Taxonomy.** The diagnosis of *P. recifinus* is discussed above. The specimen from PECB (ZSP 055; see Table 7 for measurements) has a tetracolored dorsal fur with a narrow light brown band, followed by a brown band, a paler band and a chocolate brown distal band; ventral fur is grayish light brown; facial stripes are bright and well-marked; the uropatagium have a deep notch and furred edge; ears and noseleaf edges are pale; interramal vibrissae absent; and upper inner incisors are separated, and lower incisors are reduced and separated with flat margins.

**Distribution.** In Brazil, the species is recorded in the Atlantic Forest, Cerrado and Caatinga, in the states of Alagoas, Bahia, Espírito Santo, Minas Gerais, Paraíba, Paraná, Pernambuco, Rio de Janeiro, and São Paulo (Velazco 2005, Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is recorded on all the regions, however, in few localities (Garbino 2016).

**Field observations.** In September we captured one adult male in a mist-net set at ground-level on a wide trail in sampling site M22 (Appendix 1).

### *Pygoderma bilabiatum* (Wagner, 1843)

Fig. 24

**Taxonomy.** *Pygoderma* Peters, 1863 is a monotypic genus represented by *P. bilabiatum* (Wagner, 1843) (Gardner 2008c). *Pygoderma bilabiatum* is morphologically similar to *A. centurio* Gray, 1847, whose occurrence in Atlantic Forest was recently reported (Vilar et al. 2015). *Pygoderma bilabiatum* can be distin-

guished from *A. centurio* mainly by larger size (forearm > 36 mm in *P. bilabiatum* and < 33.2 mm in *A. centurio*), by the presence of a double lip from the base of noseleaf to the corner of mouth (Lim and Engstrom 2001, Vilar et al. 2015, Díaz et al. 2016), and by the presence of “doughnut-shaped” glandular tissue masses surrounding the eyes (Tavares and Tejedor 2009). Specimens from PECB (ZSP 043, 044; see Table 6 for measurements) have tricolored dorsal fur, with a mid-brown basal band, light brown mid band and grayish brown distal band; ventral fur is light brown with white patches on the shoulders. The uropatagium is densely furred, the tragus yellowish, the eyes are well developed, and the double lip is evident.

**Distribution.** In Brazil the species is recorded in the Atlantic Forest, Caatinga, Cerrado and Pantanal biomes, in the states of Alagoas, Bahia, Espírito Santo, Minas Gerais, Mato Grosso do Sul, Paraíba, Pernambuco, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo (Carvalho-Neto et al. 2017, Reis et al. 2017). The type locality of the species is Ipanema, São Paulo state, where the species is widely distributed (Garbino 2016).

**Field observations.** The three individuals (2 males and 1 female) were captured in May and June, in mist-nets set at ground-level on dirt roads, in sampling sites M31 and M34 (Appendix 1).

### *Sturnira lilium* (É. Geoffroy, 1810)

Fig. 25

**Taxonomy.** *Sturnira* Gray, 1842 is represented in Brazil by *S. giannae* Velazco & Patterson, 2019, *S. lilium* (É. Geoffroy,



1810), *S. magna* de la Torre, 1966 and *S. tildae* de la Torre, 1959 (Velazco and Patterson 2013, Nogueira et al. 2014). *Sturnira magna* is one of the largest species of the genus, is recorded only in Acre state, Amazon biome, and can be easily distinguished from the other three congeners in Brazil by the forearm size ( $> 55$  mm in *S. magna* and  $< 51$  mm in *S. giannae*, *S. lilium* and *S. tildae*) (Giannini and Barquez 2003, Gardner 2008d, Díaz et al. 2016, Velazco and Patterson 2019). *Sturnira lilium* can be easily distinguished from *S. giannae* by the length of the ventral fur (6–8 mm in *S. lilium* and 3–5 mm in *S. giannae*); the length of the dorsal fur ( $> 8$  mm in *S. lilium* and 4–6 mm in *S. giannae*); and by the long hairs on the trailing edge of the uropatagium (short hairs in *S. giannae* – Velazco and Patterson 2019). *Sturnira lilium* and *S. tildae* differ in some morphological characters: *S. lilium* is smaller than *S. tildae* (forearm 39–45 mm in *S. lilium* and 44–51 mm in *S. tildae*); the dorsal fur is bicolored in *S. lilium* and strongly tetracolored in *S. tildae*; in *S. lilium* the inner upper incisors are narrow and usually pointed, while in *S. tildae* they are flattened and weakly bilobed; and the lingual cusps of  $M_1$  and  $M_2$  in *S. lilium* are always tall and separated by a deep notch (“serrated condition”), while in *S. tildae* they are separated by shallow notches and lack vertical edges (Gannon et al. 1989, Simmons and Voss 1998, Lim and Engstrom 2001, Giannini and Barquez 2003, Gardner 2008d, López-Baucells et al. 2016, Velazco and Patterson 2019). Specimens from PECB (ZSP 002; see Table 7 for measurements) presented a tetracolored dorsal fur, with narrow whitish basis, followed by a light brown band, a paler cream band and a mid-brown distal band, sometimes orangish brown; the contrast between the three first bands is poor, differing from the strong contrast observed in the specimens of *S. tildae* from PECB (Fig. 30). This condition is divergent from the pattern recorded by other authors – according to Gannon et al. (1989), Lim and Engstrom (2001), López-Baucells et al. (2016) and Velazco and Patterson (2019) the dorsal fur is bicolored in *S. lilium*. Venter is grayish light brown. Yellow patches on the shoulders were observed in some individuals. The upper inner incisors present large basis and separated narrower tips, bilobed or not; lingual cusps of lower molars are strongly serrated.

**Distribution.** In Brazil, the species is recorded in all biomes except the Amazon, in South, Southeastern, and part of the Northeastern and Center-West regions (Velazco and Patterson 2013, 2019). In São Paulo state, the species is widely distributed, occurring in all the vegetational formations (Garbino 2016).

**Field observations.** We captured 31 individuals, of which 27 (14 males and 13 females) were taken in mist-nets set at ground-level in sampling sites, M2, M13, M17, M20, M22, M23, M26, M29, M31, M32, M34, M35, M37 and M39, and four males in mist-nets elevated 8 m, in sampling sites M1, M31 and M32 (Appendix 1). Captures occurred in all months except November and December. We captured lactating females in March, May and June; pregnant females in February, September and October; and juveniles in January, April, May, June and August.

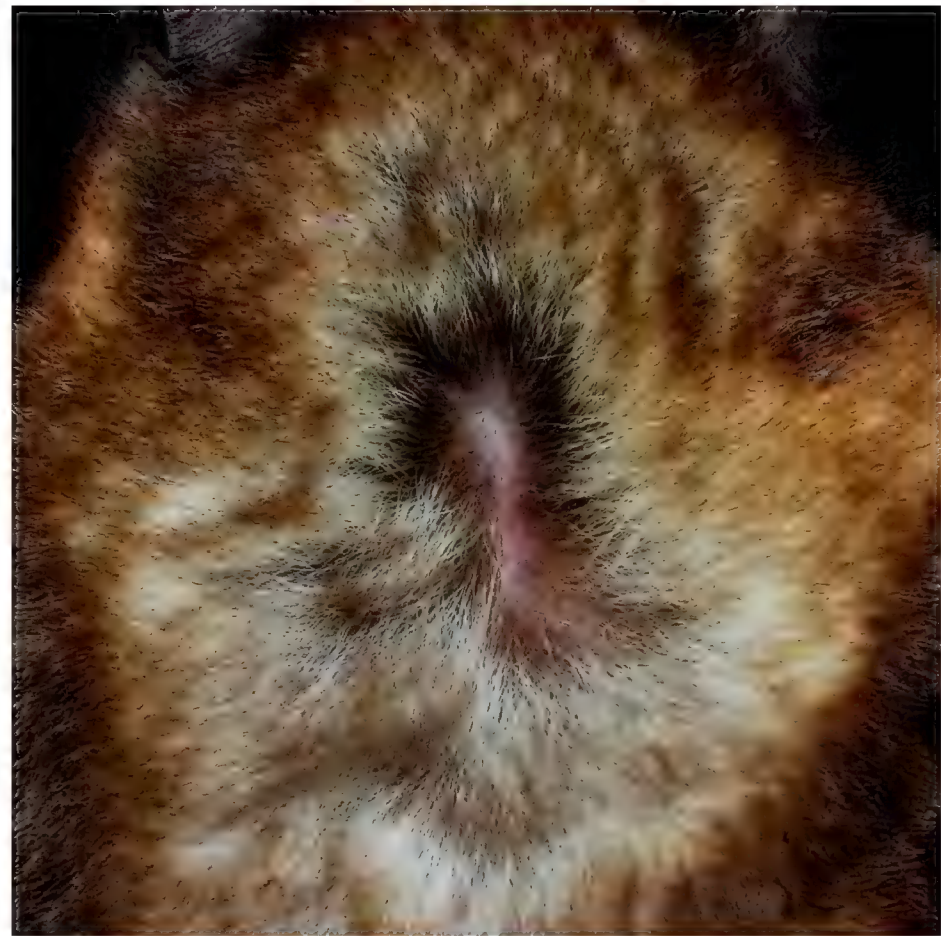


Figure 30. Tetracolored banding pattern on the dorsal fur of a specimen of *Sturnira tildae* captured in the Carlos Botelho State Park, São Paulo, Brazil. The strongly contrasting black band was absent in specimens of *Sturnira lilium*.

### *Sturnira tildae* de la Torre, 1959

Fig. 26

**Taxonomy.** The distinction between *S. tildae* and most congeners is discussed above. *Sturnira tildae* can be distinguished from *S. giannae* by the color pattern of the dorsal fur (tetracolored in *S. tildae* and bicolored in *S. giannae*); the length of the dorsal fur ( $> 8$  mm in *S. tildae* and 4–6 mm in *S. giannae*); and the length of metacarpals III and IV (Met III  $<$  IV in *S. tildae* and Met III = IV in *S. giannae* – Velazco and Patterson 2019). Specimens from PECB (ZSP 029, 038; see Table 7 for measurements) have tetracolored dorsal fur (Fig. 30), with narrow whitish basis, followed by a blackish dark brown band, a paler cream band and a mid-brown distal band, sometimes orangish brown; the contrast between the three first bands is well marked. As observed in *S. lilium*, this banding is also divergent from the pattern recorded by some authors – according to Lim and Engstrom (2001) and López-Baucells et al. (2016), the dorsal fur is strongly tricolored in *S. tildae*. Velazco and Patterson (2019), however, describe the dorsal pelage of *S. tildae* as tetracolored, this difference may be related to the fact that some authors may not consider the whitish basis (1/10 of total hairs length) of hairs as a valid band; the same seems to occur in *S. lilium*. The venter is grayish light brown. The upper inner incisors have bases and tips of the same size, in contact and bilobed; lingual cusps of lower molars weakly serrated.

**Distribution.** In Brazil, the species is recorded in Amazonia, Atlantic Forest, Cerrado and Caatinga, on the states of Amazonas,



Acre, Rondônia, Pará, Amapá, Roraima, Tocantins, Sergipe, Mato Grosso, Mato Grosso do Sul, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (Tavares et al. 2008, Reis et al. 2013, Reis et al. 2017). In São Paulo the species is distributed along the coastal Atlantic Forest (Garbino 2016).

Field observations. The five (2 males and 3 females) individuals were captured in mist-nets set at ground-level in sampling sites M5, M16, M22, M28 and M35 (Appendix 1). Captures occurred in February, April, May, June and September.

### *Vampyressa pusilla* (Wagner, 1843)

Fig. 27

Taxonomy. In Brazil, *Vampyressa* Thomas, 1900 is currently represented by *V. pusilla* (Wagner, 1843) and *V. thyone* Thomas, 1909 (Nogueira et al. 2014). In Brazil, *V. thyone* was recorded only in Amazon, in the states of Acre, Amapá, Amazônia and Rondônia. *Vampyressa pusilla* is slightly larger (forearm 32.3 to 36.0 mm) than *V. thyone* (forearm 29.3 to 34.0 mm). Additional external characters that distinguish these species are hairier legs and forearm in *V. pusilla* and legs and forearm relatively less furred in *V. thyone*; dorsal fur longer and clearly extending beyond the uropatagium edge, forming a fringe in *V. pusilla*, while in *V. thyone* the fur is shorter not extending beyond the uropatagium edge; noseleaf uniformly brown in *V. pusilla* and with a yellowish outer edge in *V. thyone*; and margin of ears faintly paler in *V. pusilla* and yellow in *V. thyone* (Lim et al. 2003, Arroyo-Cabrales 2008, Tavares et al. 2014, Reis et al. 2017). The specimens from PECB (ZSP 058; see Table 7 for measurements) have the set of characters listed above to *V. pusilla*, and presented a tetracolored dorsal fur, with narrow whitish basis, followed by a mid brownmid-brown band, a paler light brown band and mid brown tips; and venter weakly bicolored, with mid brown basis and grayish brown tips.

Distribution. In Brazil, the species is recorded in the Atlantic Forest, Cerrado and Pantanal biomes, in the states of Goiás, Mato Grosso do Sul, Bahia, Alagoas, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul (Tavares et al. 2008, Reis et al. 2013). In São Paulo the species is represented by few records from sparse localities, but all the vegetational formations (Garbino 2016).

Field observations. In September we captured an adult male in a mist-net set at ground-level on a wide trail in sampling site M21 (Appendix 1).

### Molossidae P. Gervais, 1856

### Molossinae P. Gervais, 1856

### *Cynomops abrasus* (Temminck, 1826)

Fig. 28

Taxonomy. Five species of *Cynomops* Thomas, 1920 are registered in Brazil: *C. abrasus* (Temminck, 1826), *C. greenhalli* Goodwin, 1958, *C. milleri* (Osgood, 1914), *C. mastivus* (Thomas, 1911) and *C. planirostris* (Peters, 1866) (Nogueira et al. 2014,

Moras et al. 2018). *Cynomops abrasus* and *C. mastivus* can be readily distinguished from its congeners by size (forearm > 41 mm in *C. abrasus* and *C. mastivus*, and < 39 mm in the other three species) (Peters et al. 2002, Eger 2008, López-Baucells et al. 2016, Moras et al. 2018). *Cynomops abrasus* can be differed from the northern South American *C. mastivus* by the gracile and small skull (robust in *C. mastivus*); the smooth slope of the anterior face of the lacrimal ridges on the forehead (there is an abrupt angle in *C. mastivus*); and by the presence of deep and narrow trigonid on the M<sub>1</sub> (shallow and wide in *C. mastivus* – Moras et al. 2016, 2018). The specimen from PECB (ZSP 021; see Table 8 for measurements) have general reddish dark-brown fur, and cinnamon-brown venter; flattened muzzle; upper incisors separated and resembling canines in shape; ears rounded and separated; and a rounded antitragus, without a constriction at the base. The skull characters are in agreement with the diagnosis provided by Moras et al. (2016, 2018).

Distribution. In Brazil, the species is recorded in all biomes, except Pampas, in the states of Goiás, Maranhão, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Pará, Paraíba, Piauí, Rio de Janeiro, Santa Catarina, and São Paulo (Tavares et al. 2008, Reis et al. 2017). In of São Paulo, the species is also widely distributed, occurring in all the vegetational formations (Garbino 2016).

Field observations. In December we captured an adult male in a roosting site on a building roof in sampling site S7 (Appendix 1). At the same roosting site we captured eleven individuals of *Molossus molossus* and one *Molossus rufus*.

### *Molossops neglectus* Williams and Genoways, 1980

Fig. 29

Taxonomy. Both species of *Molossops* Peters, 1866 are found in Brazil: *M. neglectus* Williams & Genoways, 1980 and *M. temminckii* (Burmeister, 1854) (Eger 2008, Nogueira et al. 2014). The external characters that distinguish these species are cited by many authors (Williams and Genoways 1980, Ascorra et al. 1991b, Lim and Engstrom 2001, Gregorin and Taddei 2002, Gregorin et al. 2004, Eger 2008, Barquez et al. 2011). *Molossops neglectus* is larger than *M. temminckii* (forearm > 34.8 mm in *M. neglectus* and < 33 mm in *M. temminckii*); and the ventral fur is darker and slightly lighter than dorsum in *M. neglectus*, and frosted or markedly lighter than dorsum in *M. temminckii*. The PECB specimen (ZSP 016; see Table 8 for measurements) have general reddish dark-brown dorsal fur with paler base; and light brown ventral fur, slightly paler than dorsum. Additionally, the muzzle is flat, ears are small, triangular and separated, the antitragus is small and rounded, and upper incisors are separated and resemble canines in shape.

Distribution. In Brazil, the species is recorded in the Amazon, Atlantic Forest and Cerrado biomes, in Amazonas, Minas Gerais, Pará, Paraná, Rio de Janeiro, Rio Grande do Sul, and São Paulo states (Gregorin and Loureiro 2011, Reis et al. 2017). In São Paulo, almost all the few records are distributed on the east region of the state (Garbino 2016).



Table 8. Selected measurements (mm) and weight (g) for specimens of Molossinae from PECB, São Paulo state, Brazil. See Material and Methods for description of measurements.

Measurement	Molossinae										
	<i>Cynomops abrasus</i>	<i>Molossus currentium</i>		<i>Molossus molossus</i>				<i>Molossops neglectus</i>	<i>Molossus rufus</i>		
	ZSP 021 ♂	ZSP 050 ♂	6 ♂ (South America)	ZSP 003 ♀	ZSP 018 ♂	ZSP 020 ♀	ZSP 053 ♀	ZSP 016 ♀	ZSP 019 ♂	ZSP 026 ♂	ZSP 059 ♂
W	30.0	22.5	–	15.5	19.0	21.0	14.5	11.5	42.0	21.0	35.5
BL	73.88	64.36	–	60.36	67.68	60.33	55.05	54.37	86.08	73.33	75.65
FA	45.50	40.43	41.25	39.17	38.94	39.50	38.88	36.73	51.11	50.32	51.20
TL	14.70	15.20	–	14.62	13.69	14.63	12.68	11.77	19.48	21.22	19.79
EL	16.64	9.57	–	11.76	12.11	12.23	11.13	11.40	13.49	13.29	15.07
TRL	4.66	4.50	–	3.66	3.85	4.93	3.79	1.83	4.40	2.97	3.60
GLS	21.58	18.92	18.89	17.46	18.26	17.99	17.34	15.57	23.97	21.82	22.92
CI	20.85	16.74	18.27	16.38	16.59	16.01	15.92	15.03	21.20	20.11	20.71
BB	10.50	9.82	9.64	8.99	9.11	9.53	9.16	8.14	11.32	11.53	10.93
ZB	15.02	11.85	11.85	11.07	10.77	11.22	10.74	10.04	14.19	13.27	14.15
PB	5.32	4.29	3.92	4.03	4.15	3.95	4.10	4.79	4.69	4.81	4.50
CC	5.62	5.01	5.04	4.46	4.70	4.62	4.23	4.27	6.26	6.04	6.53
MB	11.62	10.55	–	9.87	9.24	9.95	9.78	8.33	12.27	12.14	12.05
PL	9.32	6.95	–	6.70	6.82	6.68	6.63	7.32	8.48	8.33	8.52
MXTL	7.67	6.32	6.78	6.30	6.22	6.30	6.06	6.06	8.25	8.08	8.34
MLTL	6.21	4.97	–	4.93	4.82	4.98	4.97	4.86	6.60	6.44	6.51
DL	16.00	12.85	–	12.12	12.60	12.36	12.32	11.13	16.40	15.48	16.57
MNTL	9.15	7.39	–	7.38	7.05	7.15	6.90	7.09	9.41	9.33	9.54
CH	4.85	3.92	–	3.88	3.63	4.00	3.74	3.76	5.13	4.81	4.96

Field observations. A pregnant female was captured in November in a mist-net elevated 8 m over a trail in sampling site M7 (Appendix 1).

### *Molossus currentium* Thomas, 1901

Fig. 32

**Taxonomy.** *Molossus* É. Geoffroy, 1805 is represented in Brazil by six species: *M. aztecus* Saussure, 1860, *M. coibensis* J.A. Allen, 1904, *M. currentium* Thomas, 1901, *M. molossus* (Pallas, 1766), *M. pretiosus* Miller, 1902, and *M. rufus* É. Geoffroy, 1805 (Nogueira et al. 2014). *Molossus pretiosus* and *M. rufus* can be separated from the other four species by forearm length, which is larger than 44.6 mm in *M. pretiosus* and *M. rufus*, and smaller than 44.0 mm in the other four species (Loureiro et al. 2018). Within this group, *M. currentium* and *M. molossus* can be separated from *M. aztecus* and *M. coibensis* based on dorsal fur coloration. Dorsal hairs in *M. currentium* and *M. molossus* are bicolored with a long pale base, which is usually white and can reach from 1/2 to 1/4 of fur extent; dorsal hairs in *M. aztecus* and *M. coibensis* are unicolored or with a pale base that is incipient, grayish or buff, and not extending more than 1/3 of fur extent. The length and shape of upper incisors are also useful characters to distinguish those species; upper incisors are long with parallel tips in *M. currentium* and *M. molossus*, and short and spatulated in *M. aztecus* and *M. coibensis* (Loureiro et al. 2018).

*Molossus currentium* and *M. molossus* can be distinguished by the larger size in *M. currentium*, with forearm averaging 41.3 mm in males and 41.9 mm in females; and in *M. molossus* averaging 40.2 mm in males and 39.5 mm in females (Dolan 1989,

Simmons and Voss 1998, Lim and Engstrom 2001, Gregorin and Taddei 2002, Gregorin et al. 2011a, Loureiro et al. 2018). They can also be distinguished by the height of sagittal crest, which is high in *M. currentium* and low in *M. molossus* (Loureiro et al. 2018). One specimen of *Molossus* was identified as *M. currentium* (ZSP 050; see Table 8 for measurements) and have general blackish-brown coloration. The dorsal fur is markedly bicolored, with whitish basis extending to 1/3 of fur length and dark brown tips, and average 6.5 mm in length at the shoulders. The upper incisors are long with slightly divergent tips. Sagittal and lambdoidal crests are well developed.

**Distribution.** In Brazil, the species is recorded only in the Pantanal biome in Mato Grosso state (Loureiro et al. 2018). Our record represents the southernmost register of the species in Brazil, the first register on the state of São Paulo, and extends the species distribution in Brazil in almost 1,200 km southeastward (Fig. 31).

**Field observations.** In June we captured an adult male in a roosting site on a building roof, in sampling site S9 (Appendix 1).

### *Molossus molossus* (Pallas, 1766)

Fig. 33

**Taxonomy.** The distinction between *M. molossus* and other congeners is discussed above. Specimens from PECB identified as *M. molossus* (ZSP 003, 018, 020, 053; see Table 8 for measurements) have general mid brown coloration. The dorsal fur varies from weakly to well bicolored, with white to grayish basis extending from 1/4 to 1/3 of fur length, and mid brown tips. The dorsal fur at the shoulders average 5 mm. The upper incisors are pincer-like. Sagittal and lambdoidal crests are low.



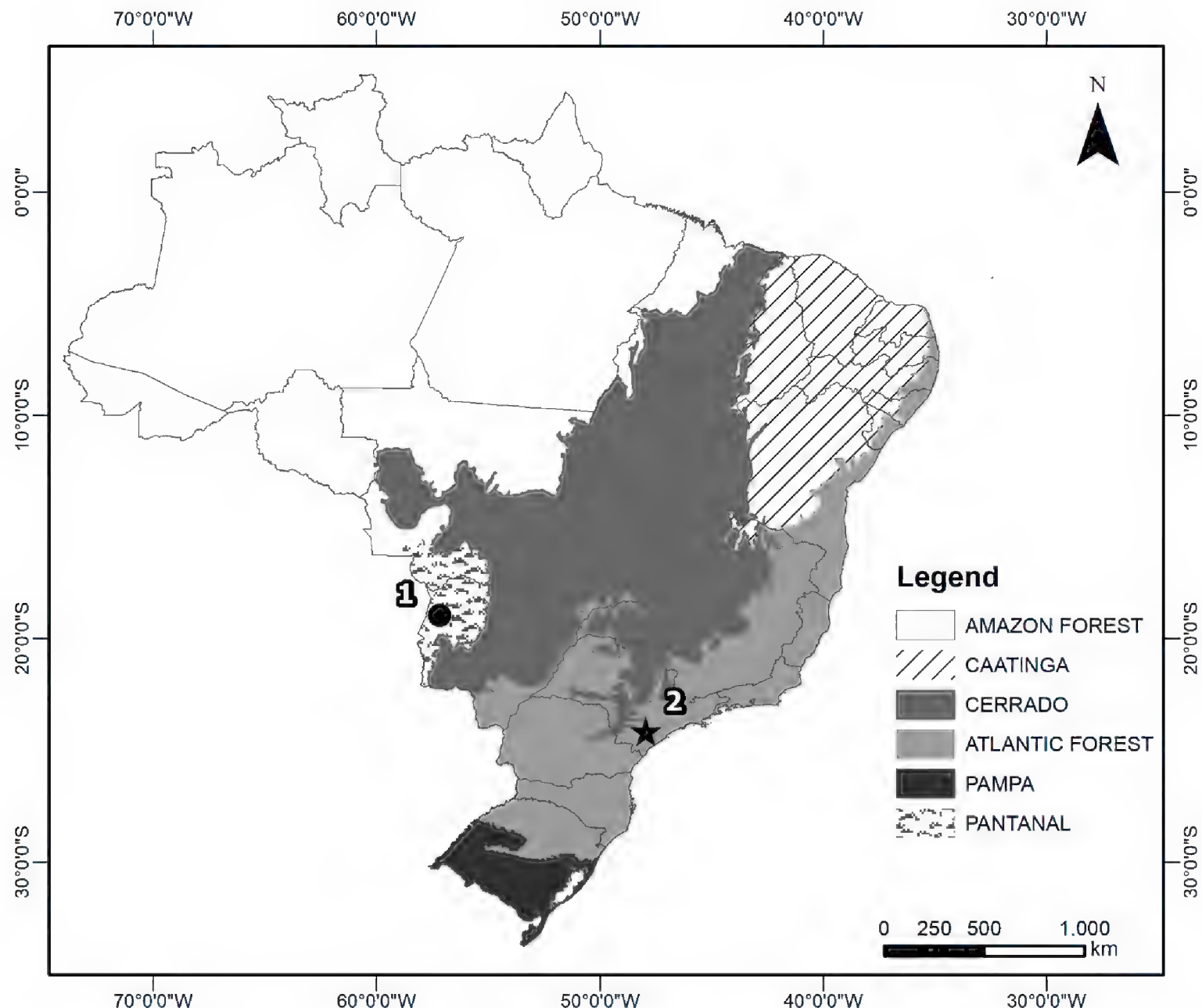


Figure 31. Distribution records of *Molossus currentium* in Brazil. Black circle: previous occurrence record; black star: new record from the state of São Paulo. The numbers correspond to the records as indicated in the Table 9.

Table 9. Locality records of *Molossus currentium* in Brazil. The map numbers correspond to the records as indicated in Fig. 31.

Map	Locality	Coordinates	Author
1	Corumbá, Mato Grosso	19°00.19'S, 57°23.48'W	Loureiro et al. 2018
2	Carlos Botelho State Park, São Paulo	24°11.00'S, 47°55.00'W	This study

**Distribution.** In Brazil, the species is recorded in all biomes and in all states, except Rio Grande do Norte (Barros 2014, Reis et al. 2017, Loureiro et al. 2018). In São Paulo state the species is widely distributed, occurring in all the vegetational formations (Garbino 2016).

**Field observations.** We captured 28 individuals (4 males and 24 females) in roosting sites on building roofs in sampling sites S2 and S7 (Appendix 1). In S2 we also captured 13 *Histiotus velatus*, two *Myotis albescens* and one *Myotis ruber*. In S7 we also captured one *C. abrasus* and two *M. rufus*. Captures occurred in October, December and July. We captured lactating females in December and pregnant females in October and December.

## *Molossus rufus* É. Geoffroy, 1805

Fig. 34

**Taxonomy.** The distinction between *M. rufus* and *M. pretiosus* from other Brazilian congeners is discussed above. *Molossus rufus* is larger than *M. pretiosus* (forearm ranging from 46.7 to 55.2 mm in *M. rufus* and from 44.6 to 49.0 mm in *M. pretiosus*); the shape of the upper incisors (long and slightly convergent in *M. pretiosus*, short, spatulated and in contact in *M. rufus*); general fur coloration (dark brown in *M. pretiosus* and dark or reddish brown in *M. rufus*) and face and membranes coloration (not black, slightly paler, in *M. pretiosus* and black in *M. rufus*) (Gregorin and Taddei 2000, Lim and Engstrom 2001, López-González and Presley 2001, Gregorin and Taddei 2002, Eger 2008, Nogueira et al. 2008, Gregorin et al. 2011a, Díaz et al. 2016). *Molossus rufus* specimens from PECB (ZSP 019, 026, 059; see Table 8 for measurements) have general reddish dark brown coloration, with unicolored dorsal fur, which average 5 mm at the shoulders. The upper incisors are spatulated and in contact.



**Distribution.** In Brazil, the species is recorded in all biomes, except Pampas, on the states of Alagoas, Amazonas, Amapá, Bahia, Ceará, Espírito Santo, Maranhão, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Pará, Paraíba, Pernambuco, Piauí, Paraná, Rio de Janeiro, Roraima, Rio Grande do Sul, Santa Catarina, and São Paulo (Tavares et al. 2008, Reis et al. 2017). In São Paulo, the species is widely distributed (Garbino 2016).

**Field observations.** We captured 3 adult males in roosting sites on building roofs in sampling sites S7 and S17 (Appendix 1). In S7 we also captured 11 *M. molossus* and one *Cynomops abrasus*; on S17 we also captured one *Glossophaga soricina*. Captures occurred in January, September and December.

## Vespertilionidae Gray, 1821

### Vespertilioninae Gray, 1821

#### *Eptesicus taddeii* Miranda, Bernardi & Passos, 2006

Fig. 35

**Taxonomy.** Six species of *Eptesicus* Rafinesque, 1820 occur in Brazil: *E. andinus* J.A. Allen, 1914, *E. brasiliensis* (Desmarest, 1819), *E. chiriquinus* Thomas, 1920, *E. diminutus* Osgood, 1915, *E. furinalis* (d'Orbigny and Gervais, 1847) and *E. taddeii* Miranda, Bernardi & Passos, 2006 (Nogueira et al. 2014). *E. andinus* and *E. chiriquinus* can be distinguished from congeners by the length of dorsal fur (> 8 mm in *E. andinus*, and *E. chiriquinus*, < 8 mm in the other species; Simmons and Voss 1998, Miranda et al. 2006, Davis and Gardner 2008). *Eptesicus taddeii* can be distinguished from *E. diminutus* and

*E. furinalis* by size (forearm 44.1–48.7 mm in *E. taddeii*, and < 42.5 mm for *E. diminutus* and *E. furinalis* – Mies et al. 1996, Simmons and Voss 1998, Miranda et al. 2006). The distinction between *E. taddeii* and *E. brasiliensis* is based on the shape of the ears (rounded in *E. taddeii* and more triangular in *E. brasiliensis*), muzzle shape (more inflated in *E. taddeii* than in *E. brasiliensis*) and size, *E. taddeii* being larger than *E. brasiliensis* (forearm 44.1–48.7 mm versus 40.5–46.5 mm; Miranda et al. 2006). Specimens from PECB (ZSP 017, 048; see Table 10 for measurements) were identified as *E. taddeii* because of the following characters: short dorsal fur (ca. 6 mm), triangular ears with rounded terminal portion, muzzle inflated, and forearm length within the variation reported. According to Miranda et al. (2006), the dorsal fur in *E. taddeii* is bicolored, with the basal two-thirds brown and tips red. This pattern was observed on the specimens from PECB, which have bicolored dorsal fur, with a large mid brown basal band and reddish tips. The ventral fur is also bicolored, with a large mid brown basal band and contrasting reddish tips, pattern similar to the described by Miranda et al. (2006).

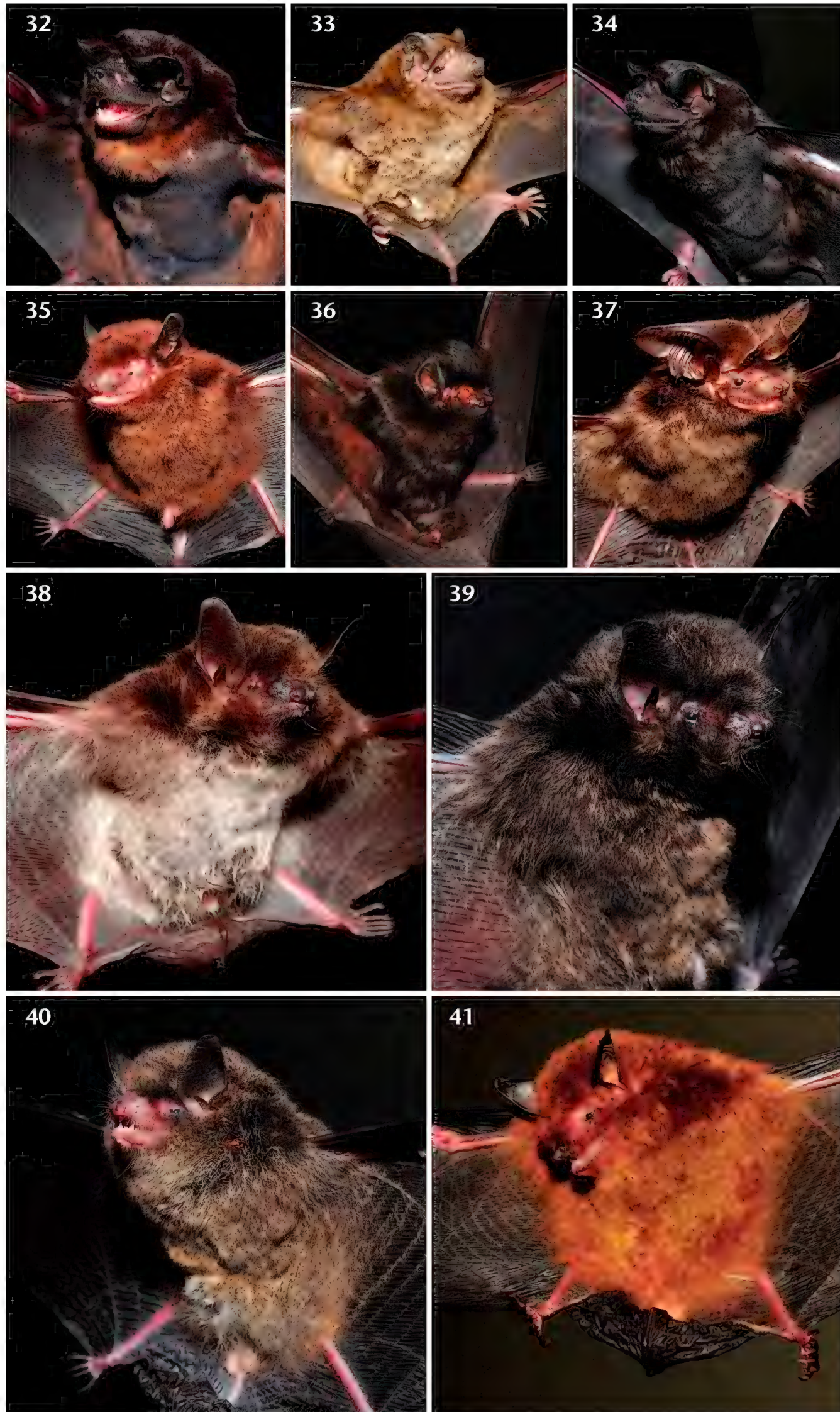
**Distribution.** In Brazil, the species is only known from the Atlantic Forest, on the states of São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Tavares et al. 2008, Reis et al. 2017). In São Paulo there are records in only three localities in the central and east portions of the state (Garbino 2016).

**Field observations.** Two adult females were taken on mist-nets set at ground-level in sampling sites M20 and M34, and one was taken on a mist-net elevated 8 m over a trail, in sampling site M7 (Appendix 1). Captures occurred in March, June and November. A pregnant female was captured in March.

Table 10. Selected measurements (mm) and weight (g) for specimens of Vespertilioninae and Myotinae from PECB, São Paulo state, Brazil. See Material and Methods for description of measurements.

Measurement	Vespertilioninae					Myotinae						
	<i>Eptesicus taddeii</i>		<i>Histiotus velatus</i>		<i>Lasiurus eburnus</i>	<i>Myotis albescens</i>	<i>Myotis nigricans</i>		<i>Myotis riparius</i>		<i>Myotis ruber</i>	
	ZSP 017 ♂	ZSP 048 ♀	ZSP 004 ♂	ZSP 046 ♀	ZSP 030 ♂	ZSP 005 ♀	ZSP 010 ♂	ZSP 051 ♂	ZSP 007 ♀	ZSP 052 ♂	ZSP 047 ♂	ZSP 054 ♂
W	12.0	12.0	13.0	11.0	12.5	9.0	5.0	4.5	5.0	5.0	7.5	7.0
BL	61.43	56.47	62.02	58.92	62.13	54.09	41.77	42.30	43.42	41.89	49.87	48.26
FA	47.33	47.15	45.80	47.42	45.67	37.15	34.07	33.74	33.46	34.39	41.23	39.32
TL	20.48	19.62	20.24	20.03	21.42	16.71	15.42	14.83	14.43	14.67	17.10	16.70
EL	16.34	10.35	26.11	27.31	15.32	11.62	12.38	11.90	11.17	13.68	14.25	16.34
TRL	6.80	7.87	12.12	12.92	7.53	6.52	5.37	6.56	6.52	6.58	8.26	9.11
GLS	17.86	17.90	18.43	18.12	13.9	14.50	13.34	13.67	13.42	13.47	15.63	15.14
CI	16.86	16.87	17.19	16.80	13.93	13.61	12.56	12.99	12.72	12.67	14.93	14.37
BB	8.29	8.29	8.20	8.04	8.28	7.05	6.62	6.27	6.67	6.96	7.19	6.85
ZB	11.79	11.98	10.18	10.15	9.91	8.50	7.80	7.98	8.17	8.50	9.54	9.44
PB	4.15	4.20	4.18	3.97	4.64	3.89	3.55	3.46	3.42	3.67	3.76	3.84
CC	5.46	5.45	5.06	4.84	5.52	3.66	3.23	3.29	3.59	3.63	4.16	4.35
MB	8.72	9.06	8.37	8.30	8.38	7.08	6.54	6.53	6.69	6.90	7.59	7.35
PL	9.30	9.11	9.11	9.21	6.38	6.86	6.83	7.00	7.07	7.16	8.07	7.98
MXTL	6.80	6.76	6.08	5.98	4.70	5.07	4.92	4.94	5.06	5.04	6.17	5.85
MLTL	5.19	5.39	5.00	4.76	3.70	4.15	4.07	4.04	4.42	4.15	5.25	4.85
DL	13.34	13.61	12.71	12.64	9.58	8.95	9.46	9.49	9.88	9.90	12.19	11.43
MANTL	8.31	8.29	6.58	7.47	5.53	6.60	6.38	6.31	6.55	6.32	7.90	7.47
CH	4.64	4.81	3.94	4.34	3.28	1.93	2.78	2.70	2.79	2.90	3.48	3.58





Figures 32–41. Bat species captured in Carlos Botelho State Park, São Paulo state, Brazil: (32) *Molossus currentium*; (33) *Molossus molossus*; (34) *Molossus rufus*; (35) *Eptesicus taddeii*; (36) *Lasiurus ebenus*; (37) *Histiotus velatus*; (38) *Myotis albescens*; (39) *Myotis nigricans*; (40) *Myotis riparius*; (41) *Myotis ruber*.



### *Lasiurus ebenus* Fazzolari-Corrêa, 1994

Fig. 36

**Taxonomy.** According to Nogueira et al. (2014), seven species of *Lasiurus* Gray, 1831 are recognized to Brazil: *L. blossevillii* ([Lesson, 1826]), *L. castaneus* Handley, 1960, *L. cinereus* (Palisot de Beauvois, 1796), *L. ebenus* Fazzolari-Corrêa, 1994, *L. ega* (Gervais, 1856), *L. egregius* (Peters, 1870), and *L. salinae* Thomas, 1902. However, Baird et al. (2015) consider *L. salinae* as a subspecies of *L. blossevillii*. *Lasiurus ebenus* can be distinguished from all congeners based on the black membranes and fur coloration. The other species present lighter colors, with fur coloration varying from reddish to yellowish, orange or whitish (Fazzolari-Corrêa 1994, Bianconi and Pedro 2007, Reid 2009). The specimen from PECB (MN 83982; see Table 10 for measurements) have tricolored dorsal fur, with black basis and tips; bicolored ventral fur, with dark-brown basis and black tips; and black membranes and face. The interfemoral membrane is furred until half of its length, the ventral region of the humera and forearms are also furred.

**Distribution.** Our specimen represents the second record of *L. ebenus* since its description (see Cláudio et al. 2018). The species was previously known only from its type locality, the Ilha do Cardoso State Park, also in São Paulo state (Fazzolari-Corrêa 1994), which is about 100 km away from PECB.

**Field observations.** The adult male was captured in February in a ground-level mist-net set over a small stream in sampling site M20 (Appendix 1).

### *Histiotus velatus* (I. Geoffroy, 1824)

Fig. 37

**Taxonomy.** In Brazil, *Histiotus* Gervais, 1856 is represented by *H. alienus* Thomas, 1916, *H. diaphanopterus* Feijó, Rocha & Althoff, 2015, *H. laephotis* Thomas, 1916, *H. montanus* (Philippi & Landbeck, 1861), and *H. velatus* (I. Geoffroy, 1824) (Reis et al. 2017). *H. diaphanopterus*, which is recorded only in Caatinga and Cerrado, can be easily distinguished by a distinctly bicolored dorsal fur, which is unicolored or weakly bicolored in the congeners and a very high skin band between ears (4 mm in *H. diaphanopterus*, and < 4 mm in the congeners; Feijó et al. 2015). *Histiotus velatus* is distinguished from the remaining species by a triangular shaped ear, which is oval in the remaining species (Feijó et al. 2015). The PECB specimens (ZSP 004, 046; see Table 10 for measurements) have weakly bicolored dorsal fur with dark brown basis and yellowish-brown tips; bicolored ventral fur, with dark brown basis and grayish-brown tips; and large and triangular ears connected by a narrow band of skin (3 mm).

**Distribution.** In Brazil, the species occurs in the Atlantic Forest, Cerrado, Pantanal and Pampas biomes, in Mato Grosso, Goiás, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul states (Feijó et al. 2015, Reis et al. 2017). In São Paulo, the species is widely distributed, occurring in all the vegetational formations (Garbino 2016).

**Field observations.** All the 13 specimens (1 male and 12 females) captured were taken in building roofs in sampling site S2 (Appendix 1). In this site, we also captured 17 *M. molossus*, two *M. albescens* and one *M. ruber*. Captures occurred in May, July and October. Pregnant females were caught in October.

### Myotinae Tate, 1943

#### *Myotis albescens* (É. Geoffroy, 1806)

Fig. 38

**Taxonomy.** In Brazil, *Myotis* Kaup, 1829 is represented by *M. albescens* (É. Geoffroy, 1806), *M. izecksohni* Moratelli et al., 2011, *M. lavalii* Moratelli et al., 2011, *M. levis* (I. Geoffroy, 1824), *M. nigricans* (Schinz, 1821), *M. riparius* Handley, 1960, *M. ruber* (É. Geoffroy, 1806) and *M. simus* Thomas, 1901 (Reis et al. 2017). *M. simus* differ from the congeners by the shorter dorsal fur (< 4 mm), and by the wing membranes attached to the tibia or to the feet by a narrow band of membrane (< 1.5 mm; at the feet by a larger band of membrane in other species; see Moratelli et al. 2011b, 2013). *Myotis albescens* and *M. levis* are externally separated from the Brazilian congeners by the presence of a fringe of hairs along the trailing edge of the uropatagium and frosted ventral fur. *Myotis albescens* can be distinguished from *M. levis* by the smaller ear length (9–14 mm in *M. albescens* and 14–18 mm in *M. levis*) and smaller body size (mean length of forearm 34.6–35.8 mm in *M. albescens* and 36.9 mm in *M. levis* – Bárquez et al. 1999, Moratelli and Oliveira 2011). The PECB specimen (ZSP 005; see Table 10 for measurements) identified as *M. albescens* fit the description of this species provided by Moratelli and Oliveira (2011) and Moratelli et al. (2013), as follow: dorsal fur silky, long, and bicolored, with blackish brown basis and mid brown tips (ca. 6 mm between shoulders); venter lighter than the dorsal fur, strongly bicolored, with dark brown basis and white tips; fringe of hairs along the trailing edge of the uropatagium present; wing membranes attached to the feet; and face and ears dark brown.

**Distribution.** In Brazil, the species is recorded in the Amazon, Atlantic Forest, Caatinga, and Pantanal, occurring in the states of Acre, Amazonas, Amapá, Bahia, Minas Gerais, Mato Grosso do Sul, Pará, Paraná, Rio de Janeiro, Rondônia, Roraima, Rio Grande do Sul, and São Paulo (Reis et al. 2017). In São Paulo the species is widely distributed (Garbino 2016).

**Field observations.** In October, we captured two pregnant females in a building roof, in sampling site S2 (Appendix 1). At the same roost, we captured 13 *Histiotus velatus*, 17 *Molossus molossus* and one *Myotis ruber*.

#### *Myotis nigricans* (Schinz, 1821)

Fig. 39

**Taxonomy.** *Myotis nigricans* and *M. riparius* can be distinguished from *M. lavalii*, which is similar in size, by the unicolored or weakly bicolored dorsal fur (strongly bicolored in *M. lavalii*;



Moratelli et al. 2011a, 2013). From *M. ruber*, *M. nigricans* and *M. riparius* can be distinguished by the absent or low sagittal and lambdoidal crests (Thomas 1902, López-González et al. 2001). *Myotis nigricans* can be separated from *M. riparius* by dorsal fur texture (silky in *M. nigricans* and woolly in *M. riparius*); and sagittal crest usually absent (Laval 1973, López-González et al. 2001, Moratelli et al. 2013, Díaz et al. 2016). *Myotis nigricans* is distinguished from *M. izecksohni* by the smaller size (forearm 30.5–38.9 mm in *M. nigricans*, averaging 33 mm; 33.1–38.3 mm in *M. izecksohni*, averaging 36.1 mm in females and 36.4 in males), and lighter general fur coloration (mummy-brown dorsal fur and cinnamon-brown ventral fur in *M. nigricans*, dark to medium-brown dorsal fur, and light brown venter in *M. izecksohni*; Moratelli et al. 2011a, Dias et al. 2015). Specimens from PECB assigned to *M. nigricans* (ZSP 010, 051; see Table 10 for measurements) have unicolored to slightly bicolored dorsal fur, with blackish brown basis and dark brown tips, averaging 7 mm on shoulder region (Fig. 42). The ventral fur is lighter than the dorsal and is bicolored, with dark brown basis and mid brown tips. The fringe of hairs on the edge of the uropatagium is absent, the wing membrane is attached to the feet, and face and ears are dark brown.

**Distribution.** In Brazil, the species apparently occurs in all the biomes, with records for the states of Amazonas, Amapá, Bahia, Ceará, Pará, Piauí, Paraíba, Pernambuco, Rio Grande do Norte, Roraima, Sergipe, Tocantins, Mato Grosso, Mato Grosso do Sul, Goiás, Paraná, Rio Grande do Sul, Santa Catarina, Minas Gerais, São Paulo, Rio de Janeiro, and Espírito Santo (Tavares et al. 2008, Reis et al. 2017). In São Paulo the species is also widely distributed (Garbino 2016).

**Field observations.** We captured 21 individuals, of which 20 (13 males and 7 females) were taken on ground-level mist-nets, in different sampling sites and elevations: M3, M4, M11, M17, M20, M21, M27, M29, M37 and M39. One adult male was captured in abandoned roof tiles, in sampling site S12 (Appendix 1). Captures occurred in January, March, April, July, August, September, October and December. A lactating female was netted in January, and a pregnant female in September.

### *Myotis riparius* Handley, 1960

Fig. 40

**Taxonomy.** The distinction of *M. riparius* from *M. simus*, *M. levis*, *M. albescens*, *M. ruber*, *M. lavalii* and *M. nigricans* is discussed above. *Myotis riparius* can be distinguished from *M. izecksohni* by the woolly and shorter dorsal fur (ca 5 mm), which is silky and long (7.8–8.5 mm) in *M. izecksohni* (Moratelli et al. 2011a, 2013). Specimens of *M. riparius* from PECB (ZSP 007, 052; see Table 10 for measurements) have a woolly and slightly bicolored dorsal fur, with blackish brown basis and mummy brown tips, averaging 5 mm on shoulder region (Fig. 43). The ventral fur is lighter than the dorsal and bicolored, with dark brown basis and cinnamon-brown tips. The fringe of hairs on the edge of the uropatagium is absent, the wing membrane is attached to the feet, face is reddish and ears are light brown.

**Distribution.** In Brazil, the species is recorded in all biomes in the states of Acre, Amazonas, Amapá, Bahia, Minas Gerais, Pará, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo, and Tocantins (Tavares et al. 2008, Novaes



Figures 42–43. Dorsal fur of specimens of *Myotis* captured in the Carlos Botelho State Park, São Paulo, Brazil: (42) *Myotis nigricans*, with almost unicolored and long dorsal fur (ca 7 mm); (43) *Myotis riparius*, with slightly bicolored and short dorsal fur (ca 5 mm).



et al. 2017, Reis et al. 2017). In São Paulo, there are records on the east region of the state, mostly on the coastal Atlantic Forest (Garbino 2016).

Field observations. One adult male and one adult female were captured in ground-level mist-nets set at wide trails, on sampling sites M2 and M39 (Appendix 1). Captures occurred in July and October.

### *Myotis ruber* (É. Geoffroy, 1806)

Fig. 41

**Taxonomy.** *Myotis ruber* can be distinguished from their congeners by the general fur coloration, which is bright cinnamon red on the dorsum and yellowish on venter, and higher sagittal and lambdoidal crests. *Myotis simus* and *M. riparius* can present similar coloration, but the attachment of wing membranes on feet and the fur length readily distinguish *M. ruber* from *M. simus*; and the larger forearm length and higher sagittal crests distinguish *M. ruber* from *M. riparius* (Thomas 1902, López-González et al. 2001, Moratelli et al. 2011b). Some specimens of *M. ruber* have reddish nails. Specimens from PECB (ZSP 047, 054; see Table 10 for measurements) have bicolored dorsal fur, with blackish brown basis and reddish tips, averaging 6 mm between shoulders. The ventral fur is lighter than the dorsal and is bicolored, with dark brown basis and reddish tips. The fringe of hairs on the edge of the uropatagium is absent, the wing membrane is attached to the feet, face is reddish and ears dark brown, and the feet nails are reddish.

**Distribution.** In Brazil, the species is recorded in the Atlantic Forest and Cerrado, on the states of Bahia, Pernambuco, Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina, São Paulo, Rio de Janeiro, and Espírito Santo (Tavares et al. 2008, Reis et al. 2017). In São Paulo state, there are records on the central and east regions, mostly on the coastal Atlantic Forest (Garbino 2016).

Field observations. We captured two adult males, both in secondary dense forest. One was taken in a ground-level mist-net set along a river in sampling site M29, and another was taken in a building roof, in sampling site S2 (Appendix 1), where we also captured 17 *Molossus molossus*, 13 *Histiotus velatus* and two *Myotis albescens*. Captures occurred in May and August.

### ACKNOWLEDGEMENTS

We are thankful to the staff of Parque Estadual Carlos Botelho for the logistical support. VCC and GPB had received MSc scholarships from Programa de Pós-Graduação em Conservação da Fauna and Fundação Parque Zoológico de São Paulo. RM has received support from CNPq, Fundação de Apoio a Pesquisa do Estado do Rio de Janeiro – FAPERJ, and the Smithsonian Institution. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES) – Finance Code 001.

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 Submitted: May 24, 2019

Accepted: March 25, 2020

Available online: September 17, 2020

Editorial responsibility: Valeria da Cunha Tavares

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 Author Contributions: VCC, GPB, VJR, FBR and RM designed the research; VCC, GPB and VJR conducted fieldwork; VCC and RM analyzed the specimens; VCC wrote the paper and designed the figures; and all authors discussed the results and commented on the paper.

Competing Interests: The authors have declared that no competing interests exist.

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APPENDIX

Appendix 1. Information on bats sampling sites selected on Carlos Botelho State Park, São Paulo state, Brazil. The mist-net (M) and search for roost (S) codes correspond to the sampling sites as indicated in Fig. 1.

Map	Plant physiognomy	Coordinates	Altitude (m)	Map	Plant physiognomy	Coordinates	Altitude (m)
M1	Dense Secondary Forest	24°03'29"S, 47°59'37"W	789	M29	Dense Secondary Forest	24°03'53"S, 47°59'59"W	709
M2	Dense Secondary Forest	24°03'26"S, 47°58'09"W	819	M30	Dense Secondary Forest	24°03'37"S, 47°59'34"W	813
M3	Submontane Dense Ombrophilous Forest	24°11'45"S, 47°55'24"W	89	M31	Montane Dense Ombrophilous Forest	24°03'55"S, 47°57'13"W	810
M4	Submontane Dense Ombrophilous Forest	24°12'05"S, 47°55'59"W	50	M32	Montane Dense Ombrophilous Forest	24°06'17"S, 47°58'49"W	752
M5	Submontane Dense Ombrophilous Forest	24°11'46"S, 47°55'34"W	75	M33	Dense Secondary Forest	24°04'00"S, 47°59'44"W	739
M6	Submontane Dense Ombrophilous Forest	24°12'05"S, 47°56'09"W	46	M34	Montane Dense Ombrophilous Forest	24°04'06"S, 47°58'08"W	848
M7	Montane Dense Ombrophilous Forest	24°03'52"S, 47°59'16"W	800	M35	Submontane Dense Ombrophilous Forest	24°11'06"S, 47°56'01"W	225
M8	Montane Dense Ombrophilous Forest	24°03'38"S, 47°58'47"W	783	M36	Montane Dense Ombrophilous Forest	24°03'32"S, 47°56'29"W	787
M9	Open Secondary Forest	24°04'15"S, 47°59'12"W	727	M37	Submontane Dense Ombrophilous Forest	24°11'41"S, 47°55'18"W	92
M10	Montane Open Ombrophilous Forest	24°08'16"S, 48°00'02"W	821	M38	Submontane Dense Ombrophilous Forest	24°11'43"S, 47°55'03"W	170
M11	Submontane Dense Ombrophilous Forest	24°11'38"S, 47°55'13"W	96	M39	Montane Dense Ombrophilous Forest	24°03'48"S, 47°59'15"W	806
M12	Submontane Dense Ombrophilous Forest	24°11'47"S, 47°55'42"W	69	S1	Montane Dense Ombrophilous Forest	24°10'13"S, 47°58'13"W	580
M13	Submontane Dense Ombrophilous Forest	24°11'43"S, 47°55'25"W	106	S2	Dense Secondary Forest	24°03'25"S, 47°59'38"W	786
M14	Montane Dense Ombrophilous Forest	24°06'16"S, 47°58'57"W	761	S3	Submontane Dense Ombrophilous Forest	24°11'44"S, 47°55'34"W	77
M15	Dense Secondary Forest	24°03'42"S, 47°58'32"W	824	S4	Submontane Dense Ombrophilous Forest	24°12'05"S, 47°56'10"W	46
M16	Submontane Dense Ombrophilous Forest	24°12'04"S, 47°55'57"W	51	S5	Montane Dense Ombrophilous Forest	24°03'52"S, 47°59'16"W	800
M17	Montane Dense Ombrophilous Forest	24°04'56"S, 47°57'04"W	836	S6	Montane Dense Ombrophilous Forest	24°03'50"S, 47°59'10"W	774
M18	Submontane Dense Ombrophilous Forest	24°12'22"S, 47°57'00"W	52	S7	Submontane Dense Ombrophilous Forest	24°11'37"S, 47°55'13"W	96
M19	Dense Secondary Forest	24°03'40"S, 47°59'18"W	775	S8	Submontane Dense Ombrophilous Forest	24°11'52"S, 47°57'13"W	120
M20	Montane Open Ombrophilous Forest	24°10'23"S, 47°59'06"W	648	S9	Submontane Dense Ombrophilous Forest	24°11'35"S, 47°55'12"W	99
M21	Open Secondary Forest	24°12'10"S, 47°56'26"W	45	S10	Dense Secondary Forest	24°03'40"S, 47°59'18"W	775
M22	Submontane Dense Ombrophilous Forest	24°11'45"S, 47°55'28"W	82	S11	Open Secondary Forest	24°04'39"S, 47°58'38"W	741
M23	Submontane Dense Ombrophilous Forest	24°12'07"S, 47°57'04"W	74	S12	Submontane Dense Ombrophilous Forest	24°12'04"S, 47°55'57"W	51
M24	Submontane Dense Ombrophilous Forest	24°12'15"S, 47°57'02"W	60	S13	Dense Secondary Forest	24°03'57"S, 47°59'31"W	781
M25	Submontane Dense Ombrophilous Forest	24°12'21"S, 47°57'09"W	55	S14	Submontane Dense Ombrophilous Forest	24°12'38"S, 47°58'02"W	110
M26	Montane Dense Ombrophilous Forest	24°06'29"S, 47°59'07"W	750	S15	Dense Secondary Forest	24°03'37"S, 47°59'34"W	813
M27	Submontane Dense Ombrophilous Forest	24°11'52"S, 47°55'47"W	65	S16	Montane Dense Ombrophilous Forest	24°03'51"S, 47°58'37"W	813
M28	Submontane Dense Ombrophilous Forest	24°12'04"S, 47°55'57"W	51	S17	Dense Secondary Forest	24°03'22"S, 47°59'36"W	788